AMERICAN MACHINIST

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Knowles "Quick Steaming" Fire Apparatus.

The engraving on this page represents an independent stationary steam fire apparatus as erected by the Knowles Steam Pump Works, for the Russell & Erwin Manufacturing Company, at their extensive establishment, in New Britain, Conn. It is so situated and connected by a system of pipes, and the boilers so constructed, that steam can be generated, and the whole apparatus put in operation by one man, in less than six minutes, and from one to ten streams concentrated on any given point in their establishment, thereby affording the most complete and efficient protection against the ravages of fire.

The boilers are safe at 500 lbs. pressure, and therefore absolutely safe at a working pressure of 100 lbs. of steam, and are durable, compact and very reliable.

This style of fire-extinguishing apparatus is designed for towns and villages, and large manufacturing or kindred establishments that are usually situated outside of cities. Upon application estimates will be furnished for the entire cost of this apparatus, including pumps, boilers, building, pipes, hose, and the works, all complete, ready for instant use. Several of them are in operation.

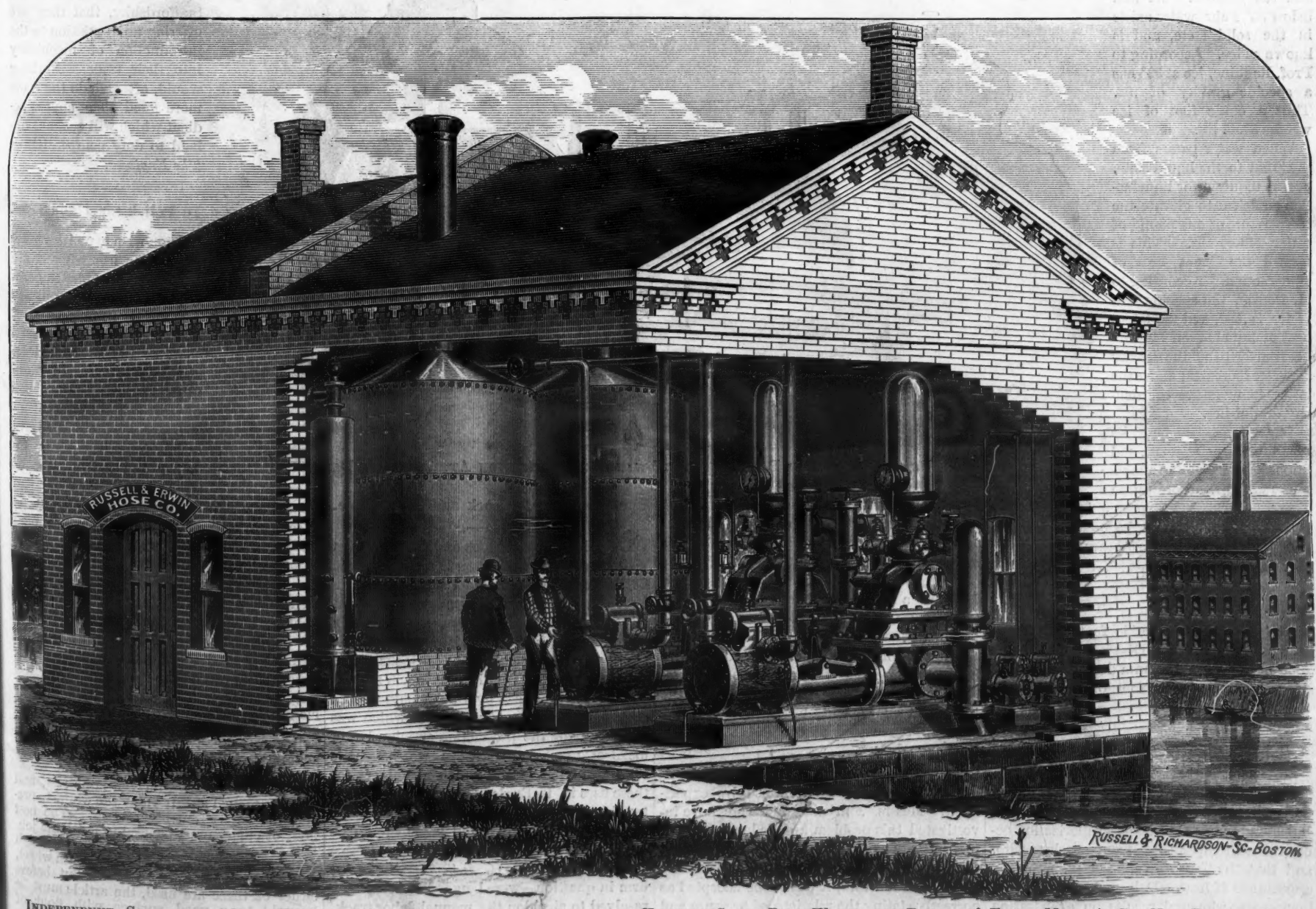
The capacity is only limited by the size of the machine. Independent stationary steam fire pumps are not only recommended by *every* insurance company, but are by many companies demanded as a condition before granting insurance.

The Knowles Steam Fire Pump, with independent boiler, combines every requisite for a first-class stationary fire apparatus, capable of throwing continuously from one to ten one-inch streams over any warehouse, factory, or steeple; or, with suitable underground pipes, from as many different hydrants in different parts of town or village, thus affording as complete protection from the ravages of fire as water can give, at a fraction of the cost of "steamers" and their appliances.

The economy of stationary fire engines, for complete protection of large manufactories, or entire towns and villages, as compared with hand fire engines, or "steamers" is worthy of careful consideration. A notable instance of this can be seen at Bristol, R. I. The pumping station is a brick building 30x32. Water is taken direct from the Bay. The pump is a "Knowles Patent" with 22 inch steam cylinder, 12 inch water cylinder, 24 inch stroke, boiler of ample surface, made expressly for this work and perfectly safe at 500 lbs. pressure. There is now laid 12,000 feet of 10, 8, 6, and 4 inch pipe, with 12 gates and 42 hydrants.

The trial test was made March 15, 1876. There were present the Chief Engineers of Providence and Pawtucket Fire Departments, and many other invited guests. The fire was lighted under the Boiler at 11.10 A. M.; two minutes thereafter there was five pounds steam, in 2.40 ten pounds, in 3.15 fifteen pounds, in 4 minutes thirty pounds, in 4.45 forty pounds, in 5.05 fifty pounds, in 6.20 ninety pounds, and the pump was started. Under the directions of the Fire Department, hose (fifty feet lengths) was attached to the hydrants at the highest point in the town, being forty-two feet above the station. Water was forced through thirty-five hundred feet of pipe, and eight streams, four of them being 1 inch streams, and four 1¼ inch streams, were thrown, during a strong wind, one hundred and twenty-five feet high, the pump maintaining one hundred and twenty-five pounds water pressure, with eighty pounds of steam; Boiler blowing off steam throughout the entire test. The entire cost to the town was $23,000, including $1,000 paid for land for the station. Only one man is required to manage the works. To throw the same number of streams, with the same pressure, would require four "first-class" steamers. For each of these would be needed engine house and stable, (not less than 25x100 ft.,) horses, harnesses, coal wagon, etc., etc, In addition to this, provision must be made with tanks or otherwise for water supply in every part of the town.

The number of men required for each steamer would be at least three to one for the stationary apparatus, and the expense for cleaning and repairs more than quadrupled. Compare the first cost of all this and the very much increased cost of maintenance with entire cost of the works herein described, and it will be found that in every point the advantages are altogether in favor of the stationary system, arranged with the Knowles



INDEPENDENT, STATIONARY "QUICK STEAMING" FIRE-APPARATUS, AS ERECTED BY THE KNOWLES STEAM PUMP WORKS, FOR RUSSELL & ERWIN MANUF'G CO., NEW BRITAIN, CONN.

Fire Pumps. The assessed valuation of the property protected by this system at Bristol is Four Million Dollars ($4,000,000). Before its introduction, the town had one "first-class steamer," and several hand engines, and yet the test trial and subsequent ones have proved so satisfactory, that insurance companies are now re-writing policies at a reduction of more than 25 per cent. from previous rates.

Where valuable property is to be protected, it is no unfrequent occurrence that the reduction in the rates of insurance will in the first year equal the cost of a pump, boiler and a complete outfit, to say nothing of the extra protection to property not insured.

For further particulars address the Knowles Steam Pump Works, 92 and 94 Liberty street, New York.

The Properties of Water.

BY JOHN W. HILL, M.E.

Water was supposed to be an element until Priestly, late in the eighteenth century, discovered that, when hydrogen was burned in a close vessel water was deposited on its sides. (It has been shown that the combustion of hydrogen requires eight parts (by weight) of oxygen, and vapor of water is the result.)

It was not, however, until Cavendish and Lavoiser investigated water that its chemical composition was determined.

The several conditions of water are usually stated as the solid, the liquid and the gaseous. Two conditions are covered by the last term, and water should be understood as capable of existing in four different conditions—the solid, the liquid, the vaporous, and the gaseous. At and below 32° Fahr. water exists in the solid state, and is known as ice. According to Prof. Rankine, ice at 32° has a specific gravity of .92. Thus a cubic foot of ice weighs 57.45 lbs.

When water passes from the solid to the liquid state, heat is required for liquefaction sufficient to elevate the temperature of one pound of water 143° Fahr. This is termed the latent heat of liquefaction. According to M. Person, the specific heat of ice is .504, and the latent heat of liquefaction 142.65.

From 32° to 39° the density of water increases; above the latter temperature the density diminishes.

Water is said to be at its maximum density at 39°, and under pressure of one atmosphere weighs, according to Berzelius, 62.382 lbs. per cubic foot. The following formulae may be used to estimate the weight of water at any other temperature:

$$D = \frac{2\,D'}{\frac{T+461}{500} + \frac{500}{T+461}}$$

where D=weight of cubic foot of water at temperature T′, and D′=weight of cubic foot of water at maximum density. Desired the weight of a cubic foot of water at temperature of 60°.

$$\frac{62.381 \times 2}{\frac{60+461}{500} + \frac{500}{60461}} = \frac{124.762}{2.001^6} = 62.331$$

Water is said to vaporize at 212° Fahr., and pressure of one atmosphere (14.7 lbs.), but Faraday has shown that vaporization occurs at all temperatures from absolute zero, and that the limit to vaporization is the disappearance of heat. Dalton obtained the following experimental results on evaporation below the boiling temperature:

Temp.	Rate of evaporation	Barometer.
212	1.00	29.92
180	.50	15.27
164	.33	10.59
152	.25	7.93
144	.20	6.488
138	.17	5.565

From this, the general law is deduced that the rate of surface evaporation is proportioned to the elastic force of the vapor.

Thus, suppose two tanks of similar surface dimensions and open to the atmosphere, one containing water maintained constantly at 212° Fahr., and the other containing water at 144° Fahr.

Then for each pound of water evaporated in the last tank, five pounds will be evaporated in the first tank.

It should be understood that the law of Dalton holds good only for dry air, and when the air contains a vapor having an elastic force, equal to that of the vapor of the water, the evaporation ceases.

The boiling point of water depends upon the pressure. Thus at one atmosphere (14.7 lbs. 29.92″ barometer) the temperature of ebullition is 212°. With a partial vacuum, or absolute pressure of one pound (2.037″ of mercury) the boiling point is 101.4° Fahr.

Upon the other hand, if the pressure be 74.7 lbs absolute, (60 lbs. by the gauge) the temperature of evaporation becomes 307° Fahr.

The relations of temperatures and pressure have been made the subject of special investigation from the time of Watt, down to the celebrated experiments of Regnault, which have been accepted as conclusive so far as they extended.

The relations of pressure and density, however, have not been determined by experiment. Messrs. Fairbairn and Tate have investigated this problem and deduced a formula, but late experience has shown that while the Fairbairn and Tate formula is perhaps the best of its kind, it cannot be accepted as correctly stating the relations of pressure and density. (Van Nostrand's Mag., June, 1878.)

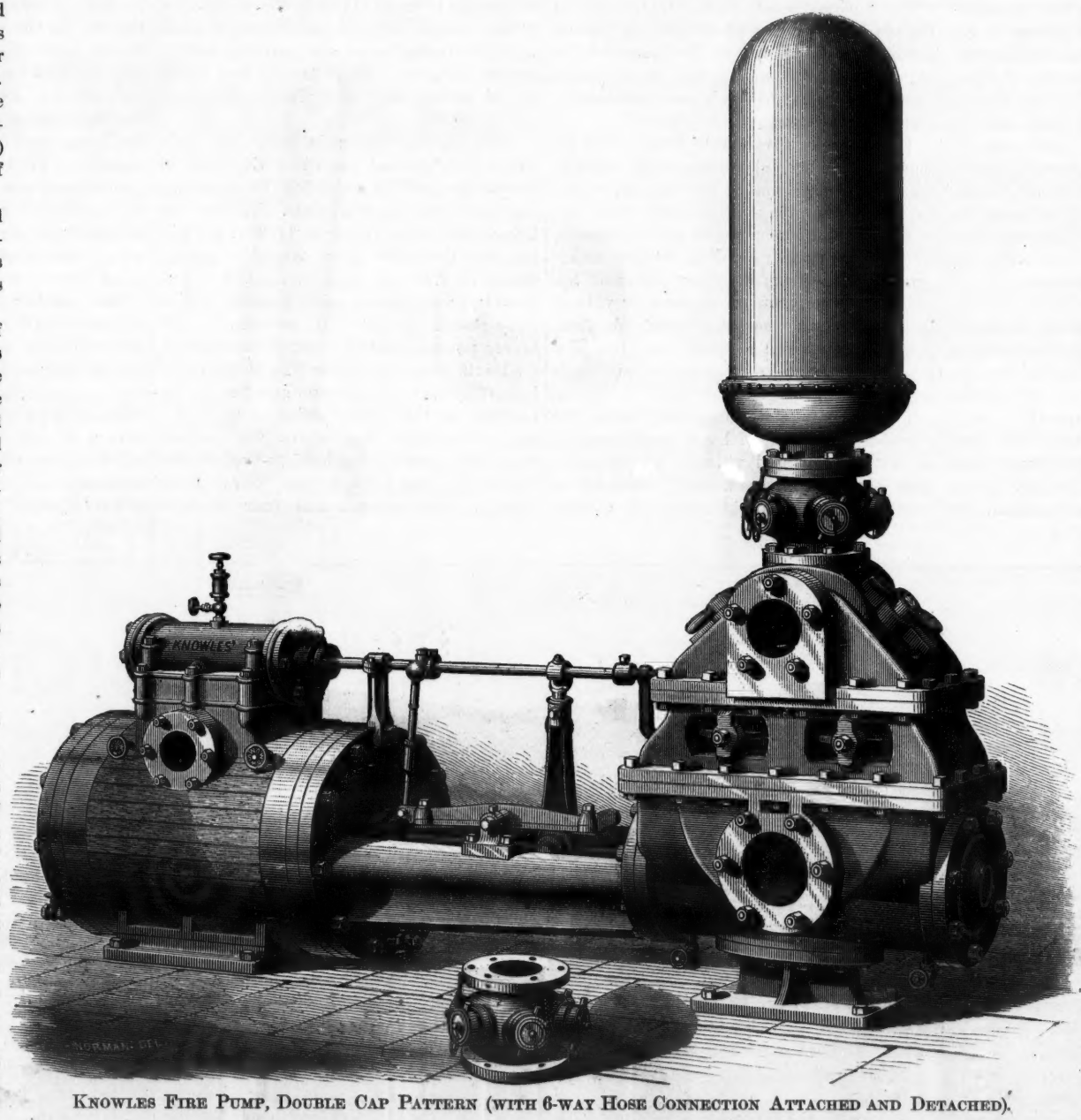
The vaporous condition of water is limited to saturation. That is to say, when water has been converted by heat into vapor (steam), and when this vapor has been furnished with latent heat sufficient to render it anhydrous, the vaporous condition ends, and the gaseous state begins. Superheated steam is water in the gaseous state.

The temperature of the gaseous state of water, like that of the vaporous, depends upon the impcsed pressure. Under pressure of one atmosphere, water exists in the solid state, at and below 32° Fahr.; from 32° to 212° it exists in the liquid state; at and above 212° in the vaporous state; and above saturation in the gaseous state.

It has been stated that water boils at 212°, but MM Magnus and Donney have shown that, when water is freed of air, it may be elevated in temperature to 270° before evaporation takes place

The specific heat of water under the several conditions are as follows:

Solid	.504
Liquid.....	1.000
Vaporous.....	.475 to 1.000
Gaseous....	.475



KNOWLES FIRE PUMP, DOUBLE CAP PATTERN (WITH 6-WAY HOSE CONNECTION ATTACHED AND DETACHED).

Machinery in the Lock and Key Trade.

The spirited firm of lock and key smiths at Willenhall have, at an outlay of betweeen £3,000 and £4,000, supplied themselves with a set of machines for the production of a certain class of locks and keys, with scarcely more manual labor than is needed for the tending of the machines. The locks are of the rim class, and the three numbers most in demand are produced by this machinery at a cost some 30 per cent. under that which was necessary for the production previously of locks of much less intrinsic worth. We know of no instance in which machinery for these uses is, in England, being employed as by this Willenhall firm. But there is no reason why wasteful hand labor should be practised to the extent now so general in this country. Messrs. H. & S. Vaughan—the firm in question—were laughed at when they resolved to abandon the manual labor track, and were, like many other pioneers in the use of machinery considered, to say the least, to be extremely injudicious. "The thing could not be done," it was declared. But these manufacturers have done it. Visiting America, their conviction of the practicability of the enterprise was confirmed. Upon returning home they were not long in devising and patenting tools for making all kinds of keys for locks. The machinery consists mainly of various modifications of well-known appliances, such as a profile machine, the clamping chuck of a lathe, ordinary cutters, and a new application of the slotting tool. By these the bow, the shank, and the bit are formed, all out of a blank of stamped wrought iron. The pin is formed by an entirely new tool, composed of a cylinder of steel with a cutting edge, which is pushed over the pin, cutting it to its exact form, the cylinder being cut away at the portion where the bit joins the pin. The lock machinery is equally simple, and after the plates have been pierced under a powerful press, all the apparatus, which is self-acting, can be tended by girls, one of whom occasionally minds four machines. With this machinery, the firm is about to produce, at a very low figure, an upright rim lock, which will run very hard the American cast-iron rim lock, which offered, it is believed, under cost, is getting into so much favor with our Antipodean fellow-subjects, and is being bought also in London. Few of our readers will deny that this Willenhall lock firm merit the publicity we have satisfaction in giving to their venture. They will have done further service to their country when they have succeeded in adapting machinery to the construction of locks of a higher order than Nos. 6, 7 and 8 rim. It is creditable to the operative lock and key smiths of South Staffordshire, that they are offering no opposition to the introduction of machinery into their trade. Nothing would, after all, do the trade more good than any expedient which will enable England to defy competition.—*The Engineer.*

To Polish Steel and Iron.

If you wish to polish a piece of steel or iron after it has been turned and filed smooth, it can be done very quickly and nicely with emery and oil. If you wish to polish a shaft or any straight piece, the best way is to use a clamp made by taking two pieces of soft pine board, about two inches wide and twelve inches long; lay them together and nail a piece of strong leather over one end for a hinge; cut a small crease across the inside of each piece, about two inches from the hinge; saturate these creases with oil, and sprinkle them with No. 100 or No. 120 emery, and place the clamp around the shaft so the creases will be in contact with the shaft; hold the long end or handle of the clamp in the hands, and press them together! run the lathe at a good speed, and move the clamp slowly from one end to the other. After you have brought it to a good surface, another clamp should be used with flour of emery and oil. If the work is irregular, then it is better to take a pine stick about one inch square, and dip the end in oil and then in emery, pressing the end against the work. The stick must rest on the lathe rest, and must be moved slowly along the work, to prevent the emery cutting creases. The best flour of emery must be used to finish the job. If it is desired to give the article a very high polish, it can be done by using a brush wheel, and then using the rag wheel. But before either of these are used, the article must be brought to a good surface with flour of emery.

Combined Tube Expander and Cutter.

Herewith are shown cuts of the patent combined boiler tube expander and cutter, which is a tool meeting with great favor in shops where it is in use. It consists of a Prosser Expander, the outside bead of which has a cutting edge, also a collar with cutting edges inside; the two cutting edges act as a shears, making a clean square cut from the end of the tube, which is manifestly a better method of cutting off the ends of the tubes than the usual practice of doing it with a chisel. The expanding of the tube and cutting off the end are both done by one operation. Tubes put in by this method being expanded on both sides of the tube plate in one operation serve as braces of the most efficient kind. This process does not reduce the thickness of the tubes at the end, therefore they retain their original strength. It is claimed that a saving of time is effected of, at least, one-half; also, that the expanders will last longer than any others in the market. They are made of Krupp's best steel by a system of duplication of parts, so that if any one piece is broken it can readily be replaced at small expense. Fig. 1 represents the Prosser Expander and Cutter, Fig. 2 a sectional view of the Expander, and Fig. 3 the Prosser Expander alone.

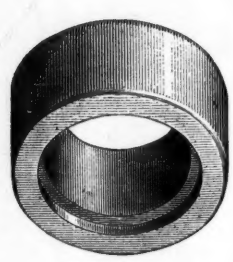
To expand and cut off a tube, the collar is placed over the end of the tube and against the tube plate *a*. The Expander and Cutter is then inserted within the tube until the gauges *j*, which are shown as shoulders on the segments, meet the end of the collar, in which position the cutting edges *i* are in proper position with reference to the cutting edge of the collar In this position the tapering mandrel is driven in, and from time to time rotated until a suitable portion of the end of the projecting tube is cut off, and the tube at the plate is properly expanded.

About one eighth of an inch of the tube end is left projecting beyond the-plate *a*, and the piece cut off is left within the collar.

When the collar and tube are removed *the projecting end is properly calked against the plate.*

The manufacturers are Thos. Prosser & Son, 15 Gold street, New York.

FIG, 1.



RING.

FIG. 3.

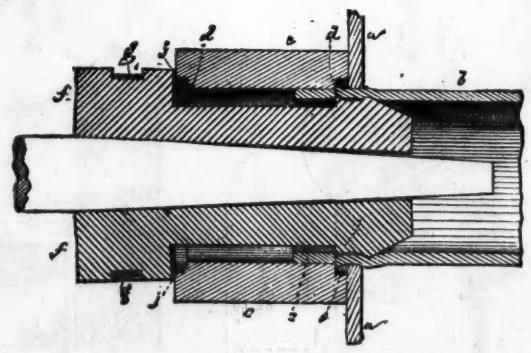


FIG. 2.

PROSSER'S COMBINED TUBE EXPANDER AND CUTTER.

Extracts from Chordal's Letters.

Messrs. Editors:—Hunter's foreman has left him; gone West to start a shop of his own.

Hunter is in real trouble now, and regrets keenly not having taken my advice, given five years ago, to encourage and build up the executive qualities of a workman when they appeared, and thus be at all times supplied with material raised in and familiar with the shop, on which to draw in cases of emergency.

Personally, I question the policy of those business men who make their business dependent entirely upon their own presence.

We find the able and successful dry goods man buying his goods to the best advantage, and selling them to patrons drawn to him by his personal qualities. He watches his markets keenly and takes advantage of every opportunity offering chances for low purchases. He makes his regular trips to his source of supply, and buys promptly by mail and telegraph. But in all these operations is his Lieutenant with him? Is he educating another man to relieve him or to take his place? If he gets sick or goes to Paris, is there a man who will do his work as well as himself? If there is such a man in the background, our merchant is a wise man and has a business which will allow him to leave it and enjoy its fruits once in a while. The average machine-shop proprietor generally carries his business in his head, and for some reason, or lack of reason, he declines engrafting his qualities of success upon a supernumerary who might often be his real salvation.

The real prudent proprietor has in his employ a man *preparing* for every important position. Out of fifty machinists about two can always be found, who by proper encouragement can fit themselves for the higher positions. They are not necessarily the best workmen, in fact good workmen seldom make good foremen or superintendents.

A man with the mental qualities required for such positions generally finds the acquisition of an art distasteful. It is not always to a man's discredit that he is not a good workman. There are rarer qualities than skill, and there is to-day, dull as the times are, a demand for *mechanics*—men who understand human nature and the quality of metals, men who can put workmen in good places where they can, by reason of adaptability, make their results profitable and their existence pleasant. The eternal fitness of things is the golden key to the placing of men in the shop. A good foreman is the most valuable man in the shop and earns his pay, not by fooling with chipping chisels and lathes, but by the discretion shown in parceling out his work among the men.

A good foreman can earn his pay by the simple increase in productive power of five men, and he does damage if he attempts to "make a hand" himself.

The demand to-day is for foremen who can secure a maximum of perfection and economy in a product. The simple or complex power of reducing wages and controlling disaffected men, will not accomplish these results. To my knowledge, many of the most profitable shops are paying the highest wages to the men.

Hunter is real despondent, and gave vent yesterday to more philosophy and profanity that I supposed there was in him. Sacket went over with me, and we listened to Hunter's doleful story. He said to Sacket: "Its all well enough for you to talk about what you have always done about foremen, but what consolation is that to a man who didn't do as you did?

"I never had a foreman who could or would make a foreman for me, except Lambert, and it only took Stebbins a month to undo all of Lambert's work. Lambert did get some men into shape for promotion, but Stebbins came and, fearing to see his feathers plucked, put them out of the shop. They all have good positions now and are beyond my reach."

Sacket said he would send him a good man, one of his own raising, and warrant the quality. This put Hunter in good spirits and he told us more of his experience.

He thinks his foreman ought to be called his tenman because he has had two a year for the last five years. Said he: "I honestly think a foreman ought to have full control of his part of the machine, but somehow I can't let go my grip. You know Chordal when you told me to send for DeLow. Well he came and we quickly settled on terms. Then he wished me to understand his views as he called them. You ought to heard them. It sounded too much like law for me and my government, so I dissented, and he said that was all there was of it. He wanted supreme control in the machine shop and insisted on my passing all instructions through him. He may have been right but it was too strong for me.

"Then I got Walker. He was simply a good workman who had never gotten over it. He had no dignity and fraternized too much with the men. He became the cause of clannish jealousy and made the shop disagreeable, so I let him go.

"Then I got Morris. He was the worst man I ever saw, and Wycoff told me he was the best man in the country. He substituted tyranny for dignified discipline, had no good judgment as to real economy, and didn't understand his men. He cut down wages to curry favor with me, and succeeded in raising the cost of my work past all reason. My cost books are well kept, and when Morris had "reduced" every really cheap man out of the shop, and got it full of men who couldn't get work elsewhere, I found things cost more than they sold for. Its hard to see through these things, but I watched the thing for a while in search of information. You know Cook who ran that thirty inch Putnam lathe? Well, that man didn't seem to amount to shucks. He was a good workman and I knew it, but he accomplished nothing, had no gumption or ambition or interest. He didn't steal time or use fine feeds or slow speeds, but he seemed indolently indifferent to everything.

"I knew he was doing more irksome work than if his ambition had been called into play. He knew how to run a lathe, but seemed to understand that he wasn't paid for knowing how, but simply for running it.

"One day I found Morris blackguarding a man fearfully, so I discharged Morris and the man too, Morris for insulting the fellow, and the fellow for not resenting it. I despise a man who has no self-respect to defend. You can't make the whole of a good machinist out of half of a man, so it was small loss to the shop.

"Then I got Lambert for a foreman. I just found out his worth when he died. I could afford to give a man like him a half interest in the shop and a salary too, and would make money by it every day.

"He knew the character of every man in a week, and shipped about half of the men, keeping only those he knew to be rough diamonds. He sent one man to another shop telling him it was impossible for him to earn much here as there was no work suitable for him. Then he took a bolt cutter man and put him on the best planer in the shop—just where he belonged.

"The man's pride received a hoist and he was giving ten times as much for his money as he was before. Then he tackled Cook, for he had seen something in the man. He saw that he was under the crust, a real good workman, so he withdrew rough work from his lathe and raised his pay. Then he put him on the best lathe in the shop, and gave him the best work and raised his pay again.

"Cook was now fulfilling his mission. He seemed to be perfectly satisfied with his position in life, walked along side of me on the street instead of falling about two inches behind, as he used to do. He got twenty per cent. more pay, and gave three times as much value in work as he did under Morris. He wore better clothes, kept a bank account and used his brains every day, for he had learned from Lambert that a machine shop was a good place to use brains in.

"Lambert worked just such changes all through the shop, and when he died, I was paying higher wages and getting cheaper work than anyone else in my line.

"Then I got Stebbins, and it took him about a month to knock down Lambert's whole structure. Then I got Morgan. He was neither good, bad, or indifferent, and the only evidence of his having been here is the vacancy he leaves behind him. * * * * Sacket gave me a slight insight into his plan of making machinists and foremen as we walked home.

"When I started, I was my own foreman. I kept as many apprentices as I could use, because I could make better workmen of them than I could hire. When a town boy became an annoyance around the shop by his intrusive and impertinent interest in things, I spotted him for an apprentice.

"Lambert served his time with me, and was one of a good lot of boys. I notice that those street boys who have to be kicked out of shops are always good boys, and make not only good machinists but good mechanics. Lambert worried me considerably before he came in the shop for good. He loafed around, and if a planer was idle he would deliberately take possession and work on some tinkering job he had on hand. A little engine or some such nonsense. Finally I set him at work on a three year apprenticeship. I first set him to chipping castings, and told him he could drop such work forever, the minute he could do it well. He seemed to understand my plan, and passed through the bloody ordeal quickly. Then I put him on a bolt cutter with the same understanding. He soon graduated, took a rough lathe then a better lathe, then a vise, then a floor.

"*He always did the most valuable work of which he was capable.*

"This was my regular plan in the shop, and secured for every man his proper sphere of action, and I always made some small difference in the pay so that they could more readily appreciate the matter. I let the boys play midshipman and take charge of the ship week about. They were all sensible, proud, ambitious boys, and I never had any complaint from workmen at being bossed by these youngsters. Many of my boys now have high places and write me frequently. There are more like them in the shop. I can leave my business a month, or my foreman can leave me forever, and it will not interrupt things at all.

I work on the artillery plan, and train number 4 to number 7's work, so that firing may be continued in case of accidents."

* * * If foremanship can be a profession, DeLow was a professional foreman. He is dead now, but I know you would like to hear something of his style if you are interested in the interior management of the shop. In my next letter I will tell you something of this very peculiar man, whose memory is revered by every proprietor or workman with whom he ever came in contact.

With respect CHORDAL.

Pratt's Combined Feed Water Heater and Boiler Feeder.

Pratt's Combined Feed Water Heater and Boiler Feeder, sold by The Steam Boiler Appliance Company, of Hartford, Conn., is a very simple and compact arrangement for heating water to a temperature of 200° to 212° Fahrenheit by exhaust steam of engines, and feeding boilers, the one apparatus answering the purpose of a separate heater and pump, while the first cost is very much less, and also the cost of connecting to boilers and engine. Being set above the boilers they are entirely out of the way, leaving the boiler-room clear.

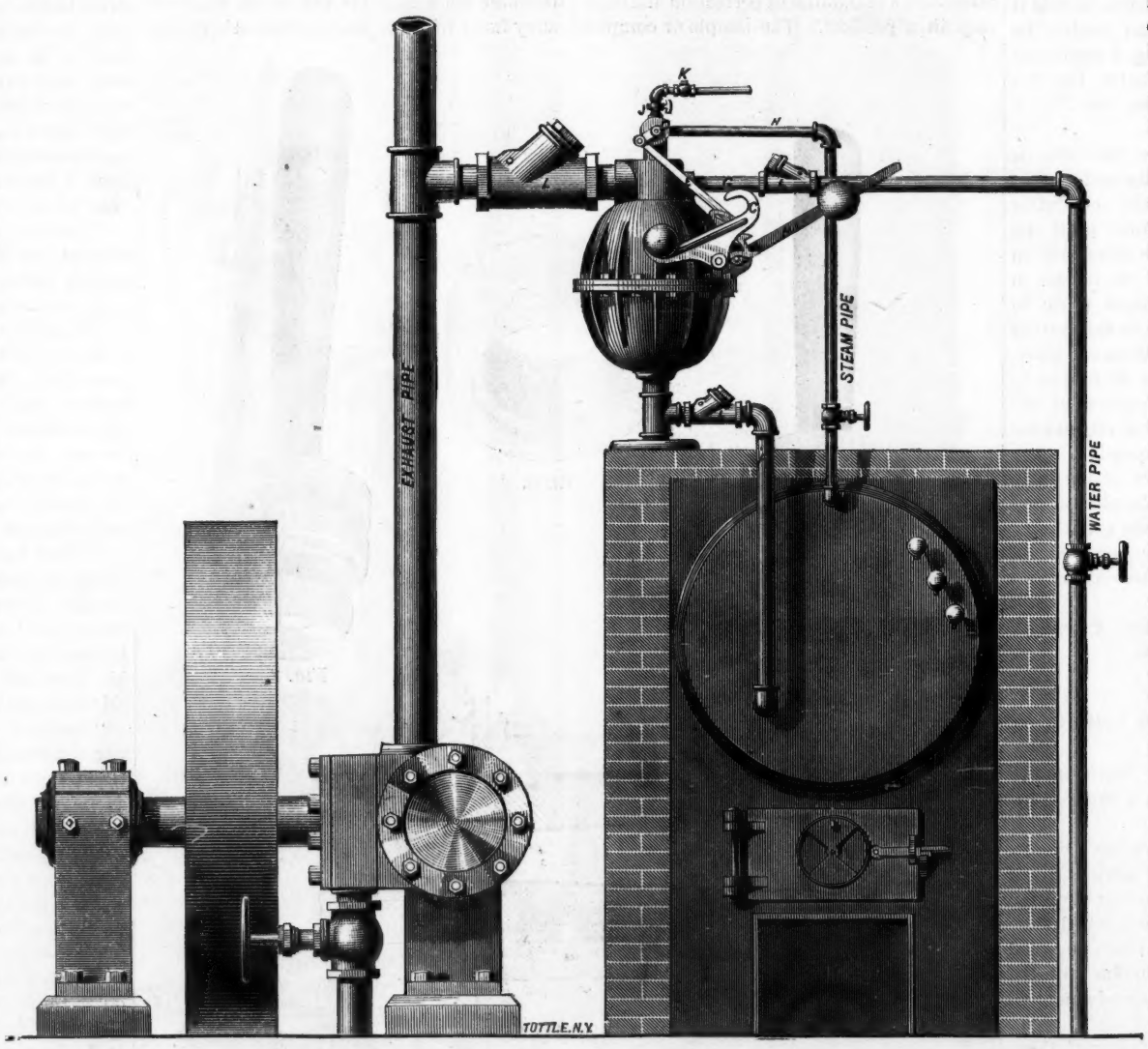
Being automatic they require no handling, all that is required is to open the valves. A brief description will make their action plain. A is a hollow vessel, inside of which is a cast-iron bucket or float, hollow and perfectly tight; this bucket is suspended on a forked lever, the other end of which is fast to a spindle, one end of which runs through a stuffing-box outside the vessel A, and holding in its outer end lever B, carrying a moveable weight. C is a rocking lever carrying a grooved weight, which rolls alternately outward and inward on the rail of C′ as the water enters the trap and flows from it to the boilers; D is a steam valve admitting steam from the boilers to the top of the water in A. H is the Steam pipe. F is discharge to boiler. L L L are check valves, one on exhaust pipe, from engine to heater, one on the water inlet, and one on the discharge. In the position shown in cut valve D is closed, and the boiler pressure shut off from Heater. The cold water will now run into the heater through a finely perforated pipe in the chamber, to which is connected the exhaust from the engine. The exhaust is drawn into the heater as rapidly as the cold water can absorb it, heating it to 200° to 212° Fahrenheit.

When the heater is full the valve D is tripped open by the rolling weight on lever C, and the boiler pressure being instantly brought on the top of water, it is discharged into the boiler by its own gravity. Steam valve D is then closed and water enters, repeating as often as necessary to supply boilers.

This heater is very effective in giving the highest possible temperature to boilers, and as a feeder, and claimed to be very economical.

Where water is so impure as to make it objectionable to use in boilers, the system of purifying used with this heater is claimed to accomplish all that can be done by more expensive heaters.

The Steam-Boiler Appliance Company, of Hartford, Conn., offer these heaters and feeders for sale, guaranteeing entire satisfaction, or, if not fully up to the statement made, they can be returned.



PRATT'S COMBINED FEED WATER HEATER AND BOILER FEEDER.

Duty of Pumping Engines.

BY JOHN W. HILL, M. E.

The term "duty" is a measure of the efficiency of an engine, and is based upon the delivery of water into the head (plus the friction of the rising pipes) per hundred pounds of coal. Duty is usually expressed in pounds lifted one foot with an expense of 100 pounds of coal.

The method usually employed neglects the actual delivery of water and head against which the pump works, but assumes that the area of the pump piston, × the average pressure of load measured to level of water in the pumping well (and the pressure due friction) × the lineal travel of the piston represents the work done, and this divided by one pound of coal for each hundred burned=the duty; or, by formula,

$$D=\frac{A\times P\times F}{C}\times 100$$

when A=area of pump piston, P=load in pounds pressure per square inch of piston, F=stroke of piston into twice the revolutions or double strokes, and C= coal consumed for travel of piston (F).

The following data is from contract trial of Milwakeee (compound) pumping engine, built by E. P. Allis & Co., Milwaukee. Diameter of pump 3.33 feet, stroke 7 feet, revolutions, 39.143, load per square inch of piston, 72.503 pounds, and coal fired 64,750 pounds. The duty, by calculation, becomes

$$\frac{3.33^2\times .7854\times 72.503\times 7\times 2\times 39.143}{647.50}\times 100=$$

$$\frac{1254.13\times 72.503\times 4\ 706002}{647.50}=76\ 955{,}720 \text{ foot pounds.}$$

This method is employed in estimating the duty when the engine pumps directly into the mains, or into a stand-pipe. When the delivery of water is into a reservoir the following method is employed; the delivery of water into the reservoir is noted either by weir measurements, or by calculating cubic contents of reservoir at beginning and end of trial, or by estimating theoretical delivery of pumps, and allowing a uniform slip (to be determined by experiment.)

When the delivery of water is very regular, or subject to slight fluctuations, the weir measure is the most delicate test of discharge, and when several engines are delivering into the same reservoir at the same time the weir measurement is absolutely necessary. When the discharge is determined by measurements of the reservoir at beginning and end of trial, previous and subsequent observations should be made of the loss of water by leakage and surface evaporation, and the calculated discharge from force main corrected accordingly.

When the actual delivery of water is made the basis for estimating the duty, the lift is taken, either by differences of levels of water in pump-well and delivery, or by taking the pressure on the rising main in the engine house, and adding the difference of level between the gauge and water in the well; to this is added an allowance for friction, and necessary resistances between the gauge and well. The delivery is usually reduced to gallons, and the weight of a gallon of water at mean observed temperature, accurately determined. Then, by formula,

$$D=\frac{G\times W\times H}{C}\times 100$$

where G=discharge in gallons during trial, W=weight per gallon, H constant head in feet to which the water is delivered, and C= coal burned, as before.

The following data is from the contract trial of the Lawrence, Mass., Pumping Engine (Leavitt, compound) built by I. P. Morris & Co., Philadelphia:

Discharge by weir measurement, 4,527,340 gallons.

Weight per gallon, 8.38 pounds.

Lift, including allowance for friction, 175.470 feet.

Coal consumed 7266. pounds,

$$\frac{4{,}527{,}340\times 8.38\times 175.47}{7266}\times 100=91{,}620{,}912,$$

to which add 5 per cent. contract allowance for slip, when the duty becomes

96,201,956.84 foot pounds.

The slip, or loss of action of the pump, being the difference between the calculated and actual delivery, varies in different engines.

In the trial of the Lynn, Mass., Engine (Leavitt, compound) the slip was 4 per cent. of the calculated capacity of the pump. In the Trenton, N. J., Engine (Wright, compound) the slip, by test, was 3.58 per cent.

In the Combination Engine, Cincinnati, non-condensing, the slip, including leakage, was 8.73 per cent.

In the Harkness Engine, Cincinnati, vertical condensing, the slip, including leakage, was 6.60 per cent.

In the Powell Engine, Cincinnati, vertical condensing, the slip, including leakage, was 8.54 per cent.

Another method of estimating the duty is to determine the mean resistance against which the pump works, including vacuum necessary to lift the water from the pump well, by indicator diagrams. This constitutes the lift. The delivery of water may be determined by actual measurement when this is practicable, or by calculating the capacity of the pump and deducting assumed slip.

The resistance due to friction and bends between level of water in pump-well, and connection of rising main with nozzle on air-vessel, is usually taken at one pound.

The Lathe and its Uses.

BY J. J. GRANT.

The lathe is probably the oldest and best known of all the various kinds of machinists' tools, and the endless variety of useful and ornamental articles it is capable of producing under the hands of a skillful workman is truly marvelous.

Lathes in a more simple form have been in use thousands of years, but within the last fifty years more improvements have been made on them than in all the previous years of their use; perhaps the most notable on engine lathes being the friction feed for the carriage, or tool slide, and a taper attachment. There has been in addition the same improvements in all the small details of manufacture as in all other machinery. There are various forms of the lathe, but the only ones we are to deal with in this article are the engine or slide lathe, as it is designated by the English mechanic, and the speed or hand lathe which should be used in all cases where it is practicable, owing to its ease of manipulation and less cost.

So much has been said and written on this subject that there would seem to be no more to say; but as a great many different views are held, an interchange of ideas will do no one any hurt, and will perhaps be of benefit to amateurs and beginners if not to experienced workmen. The cook's recipe for dressing the hare seems to be appropriate here, that is, first, "catch the hare;" the first thing in this case being to get the lathe, and in doing t his see that you don't make a mistake; a few dollars, saved in the first cost is often more than used up in the extra expense of keeping the lathe in running order during the first year. Always buy of a first-class maker. It is not the object of this article to advertise, or mention could be made of several firms that lathes could be bought of with the certainty of the purchaser getting a truly first class article. Never buy an old second-hand lathe because the price is low; poor lathes are more than dear at any price; experience is a dear teacher as the writer knows, having been through the "mill" himself.

In selecting a lathe see that the spindles are large with long bearings and plenty of belt surface on the cone pulleys; the shears, especially for fine work, should have the V-ways, and they should not be more acute than 45°, as V-ways with a less angle than this are apt to crowd and cause the carriage to run hard; all sliding surfaces should be scraped to a fit and not ground together with emery.

Be sure the leading screw is made of steel and of a perfect pitch.

Having satisfied yourself that the lathe bought is first class, the next thing is to set it up properly. Where possible, it should be set on a good firm floor; square it with the building, as hardly anything looks worse to a good mechanic than to see a tool set "askew;" level it perfectly by the bed or shears, as many a good tool has been condemned when the whole fault was in the manner in which it was set up. It is necessary that the counter shaft should be level as well as the lathe, otherwise the belt will be

apt to ride to the next larger speed on the cone, causing it to twist and soon become worthless. The oil used in lubricating should be of a good quality, as poor oil contains acid which soon destroys the fine bearing surfaces, and the gum contained in it necessitates the more frequent taking apart to clean.

The centres should be turned to the angle of 60°, leaving the head or live centre soft to allow of its being frequently turned off, which should be done before finishing every nice job.

The lathe being now ready for use, an observance of the following suggestions will prolong the usefulness of the tool for years:

Have a good board or tool holder made to fit and slide on the ways, and what is better *use it;* never allow a tool or stock of any kind to be laid on the ways; frequently run the foot stock spindle out and oil the nut in the end, as this portion of the lathe gets hard usage and generally the least attention.

A lathe in constant use should be takenentirely apart and thoroughly cleaned as often as once every six months; by so doing any surface that is wearing, or any part that wants repairs is discovered often before it becomes so badly worn as to become worthless. Use only the wrenches sent with the lathe and made to fit the nuts and screws. Finally, remember that "cleanliness is next to godliness."

In my next I shall endeavor to show some of the uses to which the lathe can be applied and the proper modes of operation.

Semi-Portable Steam Engine.

Within the last ten years there has been a rapid and ceaseless increase in the number of those manufacturers who have turned their attention to the designing and building of small vertical engines of all kinds and descriptions. Very many of these engines have had but ephemeral lives, the quality of their work being such as to sink their names in deserved oblivion, while some of those at the present time deserve no better fate, perhaps.

Of course among those who have been *pecuniarily* successful in this business there are produced engines of all grades as to quality in design, materials and workmanship, and likewise of all scales of prices, giving purchasers their choice between a low price with a cheap and soon comparatively worthless engine, or a fair (perhaps apparently high) price with a first-class engine, which is economical, easily cared for, and is as good at the end of several years running as when first started. Between these extremes there are all grades of price and quality, but here as in nearly all matters the *best* is the cheapest in the long run, and other things being equal, the *best* being found, the price, unless largely out of proportion to the increased excellence of the machine, should be of secondary importance.

This rule is pretty generally followed by purchasers of large engines, and wherever followed is fully appreciated as valuable, but with the large body of purchasers of small engines the first cost seems the prime factor, and unless the first class work is placed at very near the price of the lowest classes, the latter are selected, this being the principal reason why the "cheap" engine business has received such an impetus in the last five years.

In the line of one of the higher class of these engines we illustrate herewith the well-known "Haskins'" engine, which has had a wide sale here and in foreign countries, and has steadily built up and increased a reputation for excellence in all points which go to the construction of a first class machine. In entering upon their manufacture, over seven years ago, the builders (now forming the Fitchburg Steam Engine Company) determined to spare no exertion or expense, but to have a vertical engine which, whether large or small, should be the equal in point of design, material, and workmanship of the best of the horizontal engines of the Corliss and other types. All engines from 2-horse power to 100-horse power are made by use of special tools, jigs, and gauges, so that the parts are in perfect duplicate in every size. Any part of a 2-horse power or a 50-horse power engine can be removed and the corresponding part taken from any other engine of same size and put in its place with a certainty it will fit, and this principle has been put to the test in this company's case upon several different occasions for various causes, such as drunkenness of engineers, causing bad breakage; engines being partially destroyed by fire or water; or being broken by dropping upon wharf, and other mishaps. This method of manufacture not only ensures quick and sure repairs, but likewise a quality, accuracy, and general excellence of work, not to be obtained otherwise, except by long and expensive labor.

In small engines economy in use of fuel and freedom from wear and tear are the vital points, and the economy must come from reduction of friction to its lowest point (with good regulation), so that the force of the steam applied shall result in *useful* work instead of in overcoming the friction of the engine itself. The system of duplication of parts, because requiring special and accurate tools, and consequently accurate adjustment of engine, materially assists to reduce friction, hence to economize steam, which at the same time in exactly the same ratio it reduces the *labor* of the engine and the wear upon all working parts, increasing its economy, durability and effectiveness.

In addition to this the company use a strictly balanced valve for the induction and reduction of steam by this still further reducing the friction 10 to 30 per cent. from that occasioned by the use of the common slide valve, the well-known mechanical engineer, Joshua Rose, having in some experiments found that even more than 30 per cent. of the steam was used in overcoming the friction of the slide valve; and this is a point the importance of which can hardly be overestimated because of its relation not only to the economy of steam, but also to the reduction in work of engine, and of the boiler supplying steam.

There have been notable improvements upon these engines the past two years. *Crucible steel forgings* are now used exclusively for *crank shafts*; solid bronze or composition main journal linings and connecting-rod boxes; steel piston-rod and valve-rods; *hardened* steel wrist pins; brass lined stuffing boxes (to prevent all corrosion of rods); and others, all material, it is claimed, being the very best.

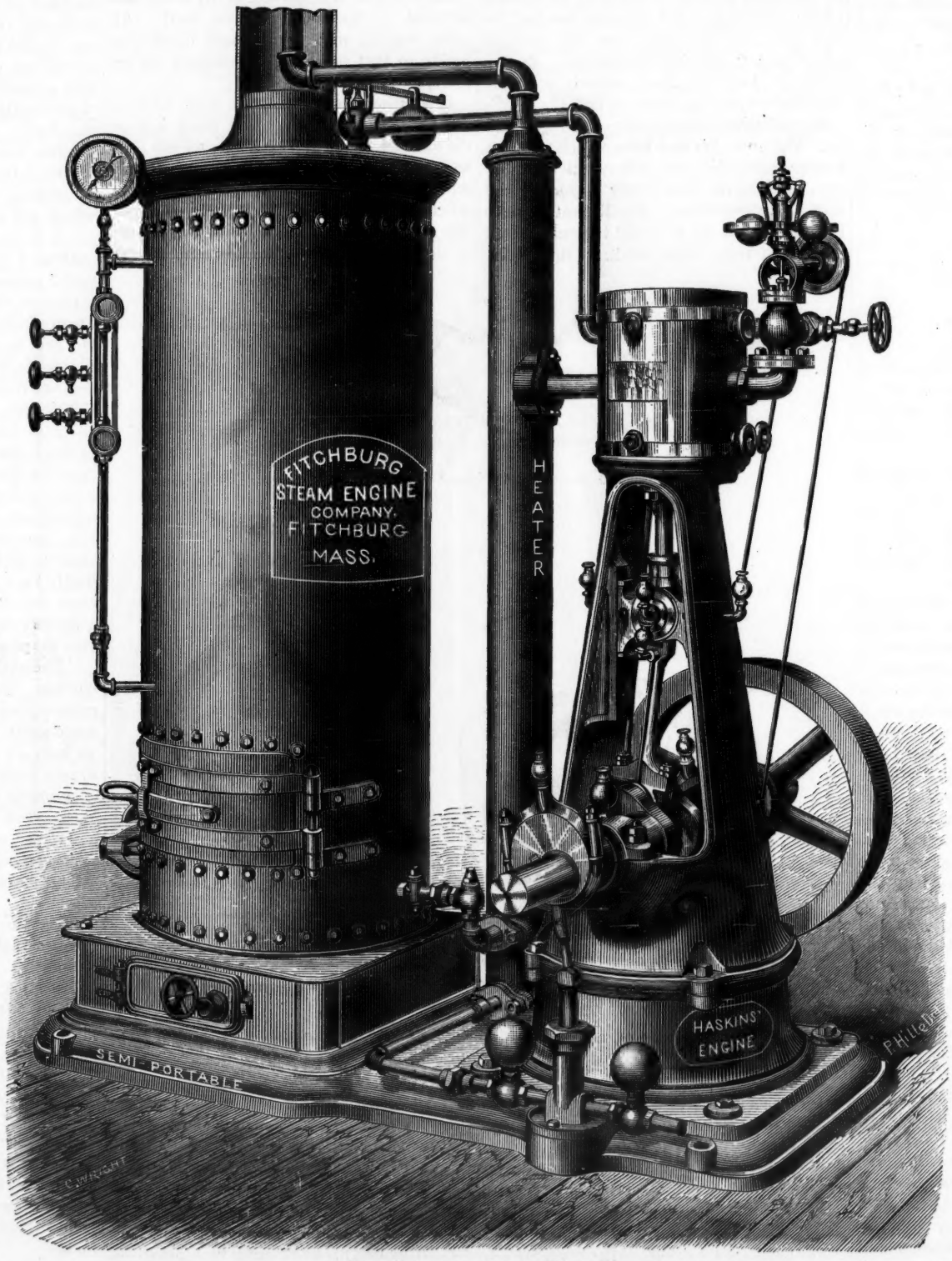
The construction of the engine is claimed to be as simple as it is possible to make an engine, the valve being moved by the plain eccentric, which is *keyed* fast to the shaft, preventing all possibility of slipping, or of change for the better (?) by wise engineers of three months' service. Each engine is tested under steam, and finally adjusted before leaving the factory, and *known* to be right for immediate work.

The governor or regulator used is the "Waters'" patent, of which over 1,000 were sold from July 1st, 1877, to July 1st, 1878, and the manufacturers guarantee, that with this governor their engines will control so absolutely that a close observer cannot detect the difference in speed of engine while at full work, reducing the power exerted from the full rated power of engine to nothing but its own friction, and this also is a direct means of economizing steam, for an engine which is first running below and then above speed by reason of poor regulation is using far more steam than is needed to do the work performed.

In most classes of work also evenness of speed is essential to the best results for quality and quantity of work produced, which, in running paper machines it is absolutely necessary if breakage of the wet paper would be avoided, so that from 100-horse power downward, these engines are peculiarly adapted to such places as paper mills, cotton and woolen mills, to help out water-power, shoddy mills, and grist mills.

The cut represents their Semi-Portable engine, it being engine, boiler, heater, pump, valves and piping, all complete upon one solid bed plate, planed true upon the bottom that it may rest upon any common floor or faced stone. This presents all the advantages of a "portable" without the great disadvantages arising from rigid connection of engine to boiler, and its consequent straining and throwing out of line, in the portable. The boiler is the simple, upright tubular, made of selected iron, and with fire box thoroughly stayed. Tubes are of best Morris, Tasker & Co's. make, and large heating surface per horse power is given. All appliances that can add to the safety of the boiler are put in, as safety valve, steam gauge, glass water gauge, three gauge cocks, and safety plug—so that serious accident is practically prevented. In place of pump and heater the company often put on the Hancock Inspirator for feeding the boiler, which is claimed to be better for some reasons, and always reliable.

The Fitchburg Steam Engine Co., whose works are at Fitchburg, Mass., have sold these engines to nearly all parts of the civilized world. They also build boilers of all sizes, and fittings for yachts and tug boats.



SEMI-PORTABLE STEAM ENGINE.

J. H. Jencks & Co., 180 Centre street, N. Y., have a machine shop supplied with the best and most efficient tools, and employ a corps of experienced workmen who have been carefully selected, each for the special work required of him. They design and make by special contracts jigs, gauges, dies and tools for the rapid and accurate production of small tools and specialties in metal work, also contract for manufacturing staple goods in quantity. One of the jobs now in progress is the manufacture of a lot of electric self-lighting gas burners, which, by the aid of a set of jigs and gauges gotten up for this purpose, are turned out accurately and at small expense. Another large job they are now finishing is upon dies for making buttons. The establishment was started last October on a small scale, and upon an increase of business enlarged to three times the original capacity, employing twenty-six men.

Some New Shop Tools.

We show below some new tools, the first of which, a forged steel S wrench, is manufactured by H. Prentiss & Company, of this city. They are forged in dies from best steel, and combine lightness, strength, uniformity and finish. Ten sizes are made, varying by eighths of an inch. The second cut, that of Reid's new drill chuck, we borrow from the new catalogue of the above-named firm. It has but four parts, and is therefore little liable to get out of order, and is very readily taken apart. The arbor hole passes through the chuck, making it very convenient for many kinds of work. It has two jaws, one with a V shaped groove in its face, and the other a corresponding ridge. The jaws are operated by a right and left screw of different pitch, and have great holding power.

The third cut shows a new lathe-dog, which is drop-forged from best bar steel, and claimed to be thoroughly hardened by the manufacturers, Lathrop & Co., Newark, N. J. Ten sizes are made, varying by quarters of an inch. They are calculated to be strong and durable.

Balancing Pulleys, &c.

BY GEORGE M. CHORDAL.

When serving my novitiate in the shop I followed the teaching of my honored but ignorant preceptor, and balanced a certain thresher cylinder on straight edges, nicely dressed and nicely leveled.

I made a good job of it. It would stand still at any point, and would stop at any point, and could be started into motion by the weight of a hair almost. I had conjured it into a state of perfect indifference, and felt satisfied with the job.

Then I took a holiday and a buggy, and went out in the country six miles to see the thresher run. The general superintendent of the institution was about as ignorant a looking man as I ever saw. We called such men "yams" when they came in the shop. When I arrived the yam was just putting the cylinder in place. He got things fixed and put the belt on and watched it a minute. The whole machine seemed to have had a fit. He stopped it and, taking a hammer and chisel, deliberately, maliciously, and sacriligiously knocked all my balancing plugs out of the heads. Then he loosened up the box caps, put the belt on and started up. He held a piece of chalk against each end pulley in turn, then stopped and drove one of my balancing plugs decisively in each end, started up again, chalked some more, stopped and chipped a little off of one plug and loaded the other a little and started again. That cylinder was in perfect balance and the machine stood solidly still.

My boyhood's pride succumbed to a new revelation, and without having spoken a word I went home. I had spent three hours time, and much skill of the highest order, in doing this cylinder no good whatever, and had then disdainfully and admiringly seen an ignorant yam accomplish real results in five minutes. The only trouble with my knowledge and skill was that I didn't know what "balance" was, or how to balance anything.

Since then it has often been my fortune to astonish my peers with my profound learning, but I have never since seen a man balancing work on straight edges, without wishing I could see him led into that distant field, and watch him pass through the throes of ignorant deliverance as I had done long years before.

Since that day I have improved my algebra, and geometry, and trigonometry, and am now able to demonstrate this balancing business, with its thesis, hypothesis, axiom, postulate, corollary, and scolium, till no practical man on the face of the earth could understand it.

I don't choose to do this, but I have an idea that about five mechanics out of six don't understand the principle or plan of "running balance," the only kind of balance rotary motion has anything to do with. Grist mill men understand the thing, or what is still better they know how to do it.

They might fool with straight edges from now till doomsday without doing a particle of good.

I give the following hints which may be of value in the shop.

If you have a shaft six feet long with a perfectly balanced pulley on one end, and an unbalanced pulley on the other end, and put it on the usual straight edges, you will find weight to be needed somewhere.

You can put it on one side of the good pulley and get your job to look perfect. It will stand still and stop still, and start easy. But you know quite well that the pulleys are not as much balance as when you commenced on them, for you have destroyed the balance of the good pulley and have not touched the bad one. At the same time the straight edges say; "This job is balanced." Such a balanced job will wear journals eccentric and shake down the tower of Babel.

Pay off these straight edges and let them go. Put your job in a lathe which will run a little faster than the pulleys will probably run. Loosen the dead center very much and start the job revolving. It will want to shake the lathe out of the shop and the pulleys will run out of true. Hold chalk to the one on the tail end. You will find a mark on the heavy side.

Put in counterbalances as usual, then fix the other end. When this work runs steady and true between loose centers it will run the same anywhere else at the same speed. A nicely made balance dog or driver is required for this business.

For a wide face pulley use a short mandrel and balance each end of it separately.

For ordinary line shaft pulleys, which seldom run over 300 revolutions per minute a lathe is as good as anything for balancing in, but for high speed work like thresher work, and wood working machine parts, a lathe center wont stand the tug.

The centers will tear out and the job start out through the shop seeking whom it may destroy.

Rig up two wooden uprights two feet high, good and solid. Have one of them to slide toward the other so as to suit different lengths of work. Cut V notches in the top of each upright for bearings and put a substantial hasp over each so the shaft cant jump out.

Put a countershaft over this machine and have cones on the countershaft and line shaft. Use this institution just as a lathe, chalking the shaft or mandrel instead of the pulley. A driving pulley must of course be put on the mandrel to belt to. There is an ingenious little machine made out West somewhere, gotten up expressly for balancing pulleys and such work. It is an upright machine nicely designed, and is of real value in any shop doing much pulley work. It won't put balancing blocks in a pulley, but it will tell where to put them very quickly.

Where no special provision is made in a pulley casting for balancing I know of nothing better than beveled strips riveted inside the rim. They should be put on a little too heavy and then cut away till all is nicely balanced.

Use two solid little clamps for attaching the test pieces. Put one clamp on the heavy side so as to balance the other one.

Thresher cylinders may be loaded by lead wedges driven in the heads, or by extra nuts screwed on the shanks of the teeth. All quick running work should have lumps cast inside so that they may be chipped off on heavy sides.

If you have a lathe whose head work is out of balance draw a black mark against the maker's name, and then balance the cone and spur gear. The cone must be balanced separately on a mandrel, by putting it into a quicker running lathe as before mentioned. The arbor is then put in with the "cone-nut" in the position it would occupy *when locking the cone.* This is also to be balanced independent of the cone.

Of course when you set the cone-nut *in* you destroy the balance, but when such is the case the spur gear has such a slow motion that it will do no harm.

Some concerns have gone largely into the pulley business, and make nice work accurately balanced for high speeds, and when a "gentile" makes pulleys nowadays he must do it good, or find his work suffer by comparison with regularly manufactured work which can be found all over the country.

If you go at it right it don't take much time to put pulleys in tip top running balance. Remember that pulleys don't use "standing balance" and that straight edges don't know anything about any other kind of balance.

FIG. 1—FORGED STEEL S WRENCH.

FIG. 2—REID'S NEW DRILL CHUCK.

FIG. 3—LATHROP'S LATHE DOG

TO DRILL A HOLE WHERE YOU HAVE NO REAMER.—It is sometimes necessary to drill a hole of an exact size to fit a certain shaft, and at the same time have it smooth without reaming it. This may be done, by first drilling a hole one-hundredth of an inch smaller than the size desired, and then making a drill the exact size and running it through to finish with. This last drill should have the corners of its lips rounded, like a reamer, and the hole should be finished without holding the drill with a rest.

A New Steam Generator.

The following extract we quote from a paper read a short time ago before the Institution of Naval Architects, in London, by A. J. Flannery, and included by Chief-Engineer J. W. King, U. S. N., in his report to Congress, January, 1877, on European ships of war:

"The almost universal adoption of high pressure steam at sea has brought with it much inconvenience, notwithstanding its great economy of fuel. The anxiety attending upon the construction and the working of the marine boiler is much greater now than formerly; its first cost is largely increased, the expense of repair is much more, and the duration of its life much less. I think I will have the concurrence of the members in saying that one of the *gravest,* if not the *very gravest* and most important of the questions now arising in connection with the machinery of steamships, is the *improvement* of the marine boiler. And not only does the present practice leave much to be desired, but the feeling in favor of *still higher pressures is checked chiefly by the difficulty* of *designing a boiler* which will *sustain them safely* and *efficiently.*"

"It is an axiom laid down by theory and confirmed by practice, that the higher the boiler pressure, and the greater the ratio of expansion, the greater is the economy of fuel. Theoretically this axiom is sustained by the fact that to generate steam of the pressure of 30 pounds to the square inch about 1.190° of heat are required, while to generate steam of 120 pounds pressure per square inch about 1.218° of heat are required; that is to say to produce steam of four times the boiler pressure less than $1\frac{84}{1000}$ times the heat is required. Again, a boiler pressure of 240 pounds per square inch requires about 1.235° of heat, or $1\frac{4}{1000}$ the heat of steam at 30 pounds and contains eight times the initial force. Practically these differences are so small that the same consumption of coal may be taken to evaporate the same quantity of water, whatever the pressure.

"Theoretically, therefore, we have only to increase our boiler pressure to reduce our consumption of fuel were it not that a well ascertained consideration intervenes, viz., we have *not hitherto been practically able to construct a boiler which, under the usual conditions of steamship requirements, will stand a pressure greater than is now in use.*

'If we could overcome the difficulty of making a boiler to bear even 120 pounds with safety, much improvement would be effected.

"To start from the beginning, let us remember that the thickness of the shell of a cylindrical vessel containing high-pressed steam must, in order to maintain the necessary strength, be increased directly in proportion to increase of pressure and diameter, and that the thickness of the shell may, consistently with the strength necessary for any given pressure, *be reduced* if its *diameter be also reduced.* A very usual size for modern high pressure cylindrical boilers is, say, 12 feet in diameter, and the thickness of the shell of a boiler this diameter, double riveted, to bear a pressure of 120 pounds per square inch, would be fully ($1\frac{1}{2}$) one and one-half inches.

"I am not aware of any examples of boiler construction where the thickness of the shell plates has exceeded ($1\frac{1}{4}$) one and a quarter inches, or $1\frac{3}{8}$ inches, and it is almost doubtful, if considering the practical difficulties of manufacture, a perfectly good job is made with shell plates of this thickness.

"On the other hand a cylindrical vessel or tube of 12 inches in diameter may for this same pressure 120 pounds per square inch, be made if welded only $\frac{5}{16}$ of an inch thick, and still possess the same proportionate strength, or for a pressure of 150 pounds per square inch it would be made practically about $\frac{1}{4}$ inch thick, and this would give a factor of safety nearly three-fourths times greater than that possessed by the cylindrical boiler shell 12 feet in diameter, $1\frac{1}{2}$ inches thick and pressure of 120 pounds. It is practically certain, therefore, that the limit of pressure with the present type of boilers has been reached, and when we consider how much economy of

fuel has been effected by increasing the pressure to its present height, and how much more economy may be effected by still further increasing the pressure, it is seen that the adaptation of an efficient high pressure marine boiler would meet a great and increasing want.

"It is pointed out also that where boilers of the ordinary type require removal, *the decks must be broken away.*"

The entirely novel method of generating steam at any pressure, superheating it, and regulating the amount of superheat, recently patented by Professor S. N. Carvalho, seems to meet the requirements indicated in the above quotation, and a description of his process will not be out of place in these columns.

The Carvalho Steam Generator and Circulating Superheater, consists of a system of coils of double lap, welded wrought-iron pipe of moderate diameter, capable of sustaining a very high pressure, which is completely filled with water, and closed so that the water contained in the system is never changed.

The system consists of four parts. The first, being a suitable furnace, into which is placed the absorbing coil. The second is a steam drum or cylinder into which is placed a second coil, and acts as a superheater. The third part is also a steam tight drum or cylinder with a third coil in it, and is the steam generator. The fourth part is an expansion chamber attached to the circuit of pipes, and of $\frac{1}{25}$ of the cubic capacity of the whole of the pipes.

When heat is generated in the furnace it is absorbed by the water (in the coil upon which the fire impinges) and which immediately commences to circulate, when the temperature of the water in the whole system of pipes has reached 212° it will have expanded nearly $\frac{1}{25}$ in volume, and entirely filled the whole circuit including the expansion chamber on the top of which is placed a safety valve.

Now as the water circulates, it gives off its heat to the colder regions of the first and second steam drums, and then returns to the bottom of the coil in the fire, and so continually repeats this process. These drums being placed at a sufficient elevation above the fire, to ensure an adequate circulation from the difference of the specific gravity of the hot or ascending column and the colder or descending column.

The second steam drum or generator is of a sufficient capacity to contain a reserve of steam, and is continually fed with a quantity of water, sufficient to compensate for the steam used by the cylinder or motor, and which is instantly converted into steam. Of course these drums are made of adequate strength, and being of small diameters in comparison with those now in use can be constructed proportionately stronger, and capable of safely resisting very high pressures.

The steam is then conducted to the first or superheating drum, and dried or superheated on its way to the engine.

When superheated steam is not desired this part of the system can be shut off by means of valves, and the water made to circulate directly from the absorbing coil in the furnace to the generator.

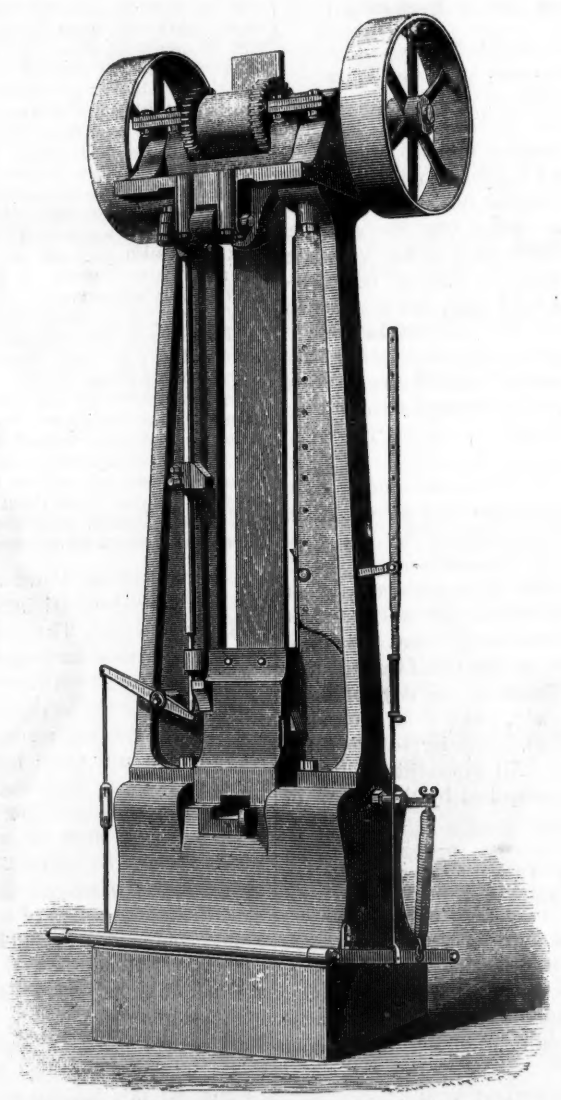
No part of the generator being in contact with the fire there is no necessity for the body of water carried in order to protect the exposed plates of ordinary boilers, and so not one-half the cubic capacity of the ordinary boiler is requisite for the same horse power, thus saving largely in the first cost. Twenty per cent. of the fuel used in the ordinary boiler being consumed in boiling this body of water, that amount is saved in the Carvalho system.

The transfer of heat being more complete and rapid, a still larger saving of fuel is made. The generator occupying much less room, and using less coal, a great saving of valuable space is effected, and in the case of steamships adding to their carrying capacity. An additional pipe, a part of the same system may be attached to the steam-jacket around the cylinder, so arranged that the hot water, at a considerably higher temperature than the steam in the generator, may circulate through it instead of steam, thereby superheating the steam directly in the cylinder. This arrangement can be used either in connection with the general plan, as described, or may be used to supersede the second part, viz., the superheating coil in superheater. In this case the steam goes from the generator to the cylinder, and the steam is heated in the cylinder.

For compound engines this device is of inestimable value. With the absorbing coil placed in the uptake, or in the gas passages of the ordinary steam boiler, and the steam passed through the first drum, superheating it, and the feed-water on its way to the boiler being passed through the second, a very large saving can be had.

By means of the same system heat can be transferred to vats for the boiling of beer or cereals, for refining oils, etc., to ovens for baking bread, crackers, etc., to drying rooms for wool, drying lumber, and any of the thousand industries where great heat under effective control is desirable.

This system, based on purely scientific principles, combining perfect safety with great economy, must eventually establish an entirely new era in the history of steam engineering.



PRATT & WHITNEY IMPROVED DROP HAMMER.

Improved Drop Hammer.

The drop hammer shown in the cut on this page has borne the test of extensive use with full success, its construction rendering it a convenient substitute for the trip hammer as well as an efficient drop hammer The drop is raised by means of a flat-surfaced strip of tough wood, which engages with the faces of finished cast-iron rolls, driven by gears at the ends. One of these rolls runs in fixed bearings, and the other has its bearings in a yoke suspended on journals which allow it to be moved toward its fellow, to engage with the surface of the lifting-board. This yoke has a central portion projecting downward and engaging by a connecting-bar with a cam operated by a vertical starting-bar through the medium of a crank-lever. By this combination, a much greater force is exerted, instantaneously, in placing and retaining the roll in contact with the lifting board, than is possible when the starting-bar is connected directly with the roll-bearings. The two rolls, with their gears, and the cam movement, are all parts of the head-piece, which may be removed as a whole, or the rolls may be removed separately. The gears are made very strong, and have a peculiar form of tooth, specially adapted to the work they perform. There are two to each roll. An automatic and adjustable stop holds the drop suspended at any height desired. An automatic trip may be attached, which will secure a series of blows of uniform force, at the will of the operator, who can, however, instantly change it from the full impact of the drop falling from the extreme height of the lift to the simple pressure of the weight of the mass without motion.

This feature—absolute control and instant adjustment of the force of the blow—is an important one. The workman has the free use of his hands in operating the machine as its action is governed entirely by the feet The foot motion is claimed to have many advantages over automatic tip, though the latter may be added if desired.

With each machine is furnished wrenches, and also a wrought-iron die-bed secured by a key. This die-bed saves the trouble and expense of dressing the main bed by chisel and file, or by planer, in case of damage, and also adds to the strength of the machine by increasing its resistance to the shock of the blow. These machines are claimed to be superior to others heretofore used, in the following respects: Weight and quality of metal, size of shafts, bearings and bolts; simplicity of construction, and of the adjustment, which is made at one point only. They are manufactured by The Pratt & Whitney Co., under Goulding and Cheney's patent with F. A. Pratt's improvements.

A few days ago Mr. Harry W. Flood, a carpenter of 64 Newark street, Hoboken, exhibited in our office a novel chest of ship carpenter's tools made by him under the light of a kerosene lamp after working hours. The chest was 3½ inches long, 1⅝ inches wide and 1¼ inches deep, and it contained a fore plane, a jack plane, a smoother, a ship adze, a ship axe, a slice chisel, a spike maul, a drawing knife, a rip saw, a cross-cut saw and an adze, eye claw hammer, all made of genuine steel well tempered and finished. The tools were all perfectly shaped and handled.

Hints on Filing.

From "A Treatise on Files," by The Nicholson File Co., Providence, R. I.

GRASPING THE FILE.—In using the larger files, intended to be operated by both hands, the handle should be grasped in such a manner that its end will fit into, and bring up against, the fleshy part of the palm, below the joint of the little finger, with the thumb lying along the *top* of the handle, in the direction of its length; the ends of the fingers pointing upwards, or nearly in the direction of the operator's face.

The point of the file should be grasped by the thumb and first two fingers, the hand being so held as will bring the thumb, as its ball presses upon the top of the file, in a line with the handle, when heavy strokes are required. When a light stroke is wanted, and the pressure demanded becomes less, the thumb and fingers may change their direction, until the thumb lies at a right angle, or nearly so, with the length of the file; the positions changing more or less, as may be needed to increase the downward pressure.

In holding the file with one hand, as is often necessary in filing light work, pins, &c., the handle should be grasped as already described, with the exception that the hand should be turned a quarter turn, bringing the forefinger on top, and lying along the handle nearly in the direction of its length. In this position, the freest action of the hand and wrist may be had upon light work.

Amateurs will find that by following these directions, the movements of the file will be simplified, and made somewhat easier than if grasped at random and without consideration.

The movements here referred to, have reference to those in which both hands are used *upon flat work*, requiring nicety and trueness of finish, and the difficulties to be overcome in producing even a comparatively true flat surface with a file require much practice on the part of the operator.

In filing ovals and irregular forms, the movements, while not considered so difficult or trying, nevertheless require considerable experience, and a good eye, to so blend the strokes of the file upon the round or curved surfaces, as to give the best effect; the varied nature of the work upon this class of surfaces, though much might be said, prevents any detailed definition as to the movements of the file, within the limit of this article.

In point of economy, the pressure on the file should be relieved during the back stroke; this will be apparent to any one who will examine the formation of the points of the teeth, when it will be seen that the file can only *cut* during the ordinary or advancing stroke, and that equal pressure during the back stroke must be very damaging to the points of the teeth.

PICKLING THE WORK.—The pickle for gray iron castings is generally made by mixing sulphuric acid and water, in the proportion of two or more parts of water to one of acid, and is usually kept for this purpose in a trough lined with lead.

The articles to be pickled are sometimes immersed in this bath, where they are allowed to remain for a short time; they are then removed, and the acid is allowed to act upon their surfaces until the scale has loosened, when they are washed off with water. More often, however, the pickle is dipped from the trough, and poured over the castings, which are placed on a sloping platform, (thus allowing the acid to return to the trough,) where, after remaining, for a sufficient time, they are then washed. When dry, the castings are either rattled, or scraped and cleaned with old files and wire scratch-brushes, until the surface is freed from scale and sand.

To pickle brass, or gun-metal castings, a mixture of nitric acid and water may be used, in the proportion of, say one part acid to five parts of water; the treatment being the same as that of the iron castings. While not in general use upon the coarser kinds of brass work, the pickle is desirable for smaller castings, or those requiring to be protected with lacquer.

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☞ *We invite correspondence from practical machinists, engineers, inventors, draughtsmen, and all those specially interested in the occupations we represent, on subjects pertaining to machinery.*

NEW YORK, AUGUST 15, 1878.

Care of Shop Tools.

The importance of taking proper care of shop tools is not recognized to the extent it should be, though every mechanic will admit that the subject calls for attentive consideration. First cost of tools seldom represents their ultimate cost, whether it becomes necessary to repair them or not. If a good mechanic makes a tool last a year in constant usage, while his careless neighbor uses up one of the same kind in six months, the cost of the latter should be accounted twice that of the former. When repairs are made their value must be added in computing the whole cost of the tool.

One primary reason why some shops can show a greater profit on a given amount of work is because they get more service out of their tools. This is just as evident when tools are cheap as when they are dear, for the products of mechanical labor fluctuate the same as the first cost of tools; and if a large part of the income of business goes for working tools and repairs to the same, balances on the right side of the ledger are likely to be diminutive, if indeed they appear at all. It is the first requisite that tools and machines should be adapted to the work to be performed. Fine tools should not be used on heavy, coarse work. They must also be kept in good working order, cutting edges well sharpened and bearing surfaces lubricated, shafting kept well aligned, pulleys balanced, belts kept clean and pliable and at the correct tension, rust prevented, emery wheels and grindstones trued up and dirt kept out of all wearing parts. Machines should be mounted on stable foundations and run neither above nor below the proper speed required to do the work. Small tools demand as much care as large ones, and a careless or inexperienced workman will often spoil more than the amount of his wages in files, drills, chucks, reamers, taps, dies, calipers, wrenches and the like, unless closely looked after by the master mechanic. It is therefore very essential, in order to insure proper care of tools, that workmen know just how to use them. All small tools should be laid away systematically in a dry place when not in use. In large shops a room should be set apart for this purpose and a man detailed to take charge of it and keep the tools in good working order. There is no part of a large machine shop from which an outsider can form a better judgment of the general management than by an observation of the tool room. The best economy is established by securing none but the best tools at the outset, for in the long run they will be found the cheapest. As a rule it is expensive trying experiments by purchasing tools of new and untried patterns or material. New machines and tools are often constructed so as to leave no reasonable doubt of their successful operation, but this is not invariably the case. It is always safe to buy those about the working of which there is no doubt. Second hand machinery can often be obtained in good order at very low prices, if the purchaser has extra time at his disposal to look it up, but when machinery is much worn its value is questionable at any price. It is not only easier but a greater satisfaction to take care of good tools than of poor ones.

Superstition among Mechanics.

The superstitious beliefs that are sometimes entertained among good mechanics are remarkable. Farmers are laughed at for "planting potatoes in the moon," but mechanics often act upon notions equally absurd. There are a number of machine shops within an hour's ride of our office that have each a horse shoe nailed over the entrance door to bring good luck and "keep the witches out." This, we believe, was originally a New England idea, but it seems to have given way in that section to the advance of popular intelligence. Last winter when the new rolling mill of the Newark Steel Works approached completion and the machinery was placed in postion, it became evident that everything would be in readiness to start the mill on Friday morning, but the workmen rebelled against such a proceeding, because Friday is an unlucky day, and they contemplated with horror the accidents and annoyances that were likely to be the fate of the luckless operatives in that mill if its first working should date from Friday. So firmly fixed were they in this belief that the mill was started on Thursday, one day before all had been made ready, and a small amount of work accomplished, in order to avoid the curse of Friday. All superstitious notions of this kind are dispelled by the spread of popular intelligence.

Are Old Boiler Tubes Re-drawn Better Than New?

By chance, a few days ago, we came across a copy of the *Manufacturer and Builder*, published in this city, and bearing date July, 1878, which contains the following frantic effort to bolster up the declining Eagle boiler tube deception:

SAFE BOILER TUBES.

The elements of safety are good quality of the material used and a proper manner of treatment in order to produce the article. This is applicable to the iron industry as to many others; but iron possesses, as is well known, the very valuable property of improving in quality by being properly worked over and over again. Old horse-shoes and other small articles, properly welded together, produce articles of a quality superior to those made of new iron; and even in the manufacturing iron industry the re-rolling and again re-rolling is an important process, generally known to give a product of which the value depends greatly on the amount of labor spent in this way on the material.

Iron tubes are no exception to this rule, and the only question is to re-draw them properly so as to improve the quality, obliterate the seam, which is often a weak part of tubes drawn in the usual way, and at the same time to strengthen other weak parts if they exist.

The Eagle Tube Company, of 614 to 626 West 24th street, New York, operate a process by which not only all this is accomplished, but by which tubes that have been used are actually made better than when they were new. The process consists in heating them in the ordinary furnace, such as is used for heating tubes and long bars; this of course throws off all scale and rust, and then the tube is drawn through a die a very little smaller than the tube; a repeated heating and drawing through smaller and smaller dies reduces its size some 20 per cent., while its length is only increased about 8 per cent. The material lost in thickness is most all consumed in thickening the thinner and weaker parts, by the powerful compression which the tubes undergo by passing through the conical dies, which diminishes the interior diameter in a still larger ratio than the outer, so that the tube comes out of this operation much thicker and stronger than it was before.

These tubes indeed withstand a higher pressure, outward as well as inward, than any of the ordinary tubing in the market, and it is nothing but a prejudice of some who disapprove of this useful new branch of industry, to pretend that they are unsafe, calling them second-hand boiler tubes. One might as well call second-hand rails those which have been re-rolled from old rails, while in fact they are better than those made from ordinary new iron.

We have indeed before us an article from a contemporary, evidently written in an interest opposed to this new branch of business, and in which boiler-makers are warned against the use of such re-drawn tubing. The grounds given as a reason are simply a proof that the writer had not only no knowledge of the behavior of iron in the fire, but does not even possess common sense. He says that in the process of re-drawing, the rust and scale adhering to the outer surface will be pressed into the iron, making weak spots, while the weak spots already existing will be made weaker. Now, the fact is that the rust and scale peel off from red-hot iron, especially when it is drawn through a die, and in watching the process we have satisfied ourselves that the tubes, after passing through the die, are perfectly clean, while an examination after they are finished not only shows a thickening of the weaker and thinner spots, but an actual and total obliteration of the seam; and we have seen these tubes tested to a hydraulic pressure of 2,000 pounds to the square inch, outward as well as inward, without any change.

We have seen them drawn to $\frac{1}{4}$ inch in thickness, well calculated for hydraulic purposes; for very high pressures these tubes may be made extra thick.

As these tubes are not only better, but also cheaper than others, we predict for them a growing and prosperous business, endorsing what our contemporary, the *Engineering and Mining Journal*, says of the Eagle Tube Company, namely: "Let them produce the facts and certified tests, and they will transform the attack into an advertisement."

A perusal of the above makes it evident that the writer was striving to develop three leading points: 1st, That the Eagle Tube Co. operate a process for redrawing iron boiler tubes that have been used by which they "*are actually made better than when they were new.*" 2d, That it is an error founded upon prejudice to call these tubes second-hand, therefore *they are new tubes.* 3d, That (supposing them to be good for nothing to use in steam boilers) if made thick enough they are "*well calculated for hydraulic purposes.*" This unique method of treating the subject reminds us of the familiar story of a western board of county commissioners who held a session and passed three resolutions, to wit: 1st, That a new jail be built. 2d, That the new jail be built out of the material in the old one. 3d, That the old jail stand until the new one is built. Whether the new jail was built according to this improved plan the records bear no evidence, but if so, it must in some respects have borne a striking resemblance to the "new" Eagle boiler tubes.

In order to have equalled the masterly logic and subtle philosophy of the article above quoted, the western commissioners should have passed another resolution like this: Resolved, 4th, that the new jail (if made strong enough to keep out thieves) will be "well calculated" for a sheep fold. Doubtless if the three resolutions were carried out, the work on the jail completed (while kept secure from the gaze of prying eyes) and overspread with a thick coat of whitewash, the board employed two or three learned engineers to examine and report upon their "process" of rebuilding, and who unquestionably gave a certificate that it was not only practicable but well calculated to strengthen the material and produce a structure absolutely free from any weak part. Probably the next step was to engage a scientific editor to publish an article commending the process and the remarkable strength and safety of the jail, at the same time asserting that any one presuming to cast doubt upon the excellent working of the process not only was ignorant of jails but entirely destitute of common sense. But "comparisons are odious," and we forbear.

One of the worst mercantile deceptions of which we have any knowledge consists in redrawing old worn boiler tubes and offering them for sale as new and reliable tubes. Can any reputable newspaper or any skilled engineer offer an adequate excuse for such a business? Steam boilers are often too weak for safe operation at reasonable pressures when made of new materials, as frequent explosions and loss of lives under fair engineering abundantly attest. What then can be expected from old redressed materials?

If we were to accept the theory advanced in the above article, let us inquire to what conclusion it would lead us. Iron, we are told, improves in quality by being properly worked over and over again. Proceeding upon this premise we are further assured that the reheating and drawing process developed by the Eagle Tube Co. greatly improves the quality of iron, and makes boiler tubes that have been used better than when they were new, the only loss being 20 per cent. in diameter. Were this true, it must of necessity follow that after another period of use in a boiler the same tubes again redrawn, by the same process, would be made still better than they were by the first redrawing, and so would continue to be made better and better by successively using and redrawing, until a quality and strength would be attained absolutely amazing.

Absurd as this conclusion appears, it is fully warranted by the above theory. As there is a wide range between the large and the small tubes, the former could be reduced one-fifth in diameter many times without departing from practical sizes. If the practice of reheating and drawing over old iron boiler tubes made them better than new, reheating old iron boiler plates and rolling them thinner must likewise make the plates better than new, for both are manufactured of the same kind of iron. If the Eagle tube industry proves as prosperous as predicted in the article above quoted, doubtless a boiler plate industry will soon be established on the same plan.

Much stress is laid upon "thickening the thinner and weaker parts."

Any one at all conversant with the working of iron, can readily see that if a tube is of irregular thickness, the redrawing process here described will not make it uniform. If part of the tube is corroded or burned more than another, it is impossible to make all parts of uniform thickness or strength by redrawing through conical dies. We are asked to believe that simply heating a tube red hot and drawing through a die without mandrel or flux will perfect a faulty weld. Tell this to the marines, but not to the poorest country blacksmith, who knows that a much higher heat aided by concussion is required to properly cement two surfaces of iron. To throw off all rust and scale, the blacksmith would heat a piece of iron beyond redress; but boiler tubes *white hot* might be awkward to draw through a die and preserve their form. We admit that our "knowledge of the behavior of iron in the fire" differs from that displayed in the article here copied, but are convinced that when a scientific editor has too many irons in the fire, some of them may evince a strange "behavior," in fact cut up antics both wild and unaccountable. That rails are made from old rails "are better than those made from ordinary new iron," is a scientific discovery of no small importance, and one of which our contemporary deserves the entire credit. Somehow railroad men decline to recognize the superior merits of rerolled iron rails, refusing to pay as much for them as for rails rolled from "ordinary new iron" (probably on account of prejudice), and when ordering a lot rerolled, generally insist upon having a strip of new iron rolled on the wearing surface of each rail. Perhaps if railroad men would carefully read the scientific journal above quoted, they might be convinced of their lack of correct judgment. If our neighbor would know why rerolled rails cannot be called second-hand, let him visit a mill where they are manufactured. He would first see the old rails cut up into short pieces piled with a piece of new iron on the top, heated in a furnace white hot, passed through the rolls (not the semblance of a rail to be

traced in the mass), again heated and rolled until lengthened out and shaped into a rail 30 feet long. The old rails entirely lose their identity, their material alone appearing in the new product. How does this resemble the redrawing of old tubes? As above described the latter are heated and drawn through a die, the operation being repeated a few times, the form and substance of the tubes remaining throughout. Their identity is not lost for a moment nor is it claimed to be; however, when the tubes come out they are advertised and sold as being "manufactured" by the concern redrawing them, on the presumption that they are new tubes. Just how the old tube is transmogrified into something else, and how the result can be a new tube, are questions that would puzzle the most learned professor of intellectual philosophy in any college or university.

Eagle boiler tubes have been fixed up and sold to some extent for many months, and if safe and good the company should be able to produce testimonials to this effect from boiler-makers who have used them. We have seen in print favorable certificates from engineers who have examined some of the tubes, but not one from a manufacturer of boilers; indeed, the most diligent inquiry on our part for the past six months has failed to discover a single boiler-maker who will admit that he uses them. In proof that we have no desire to misrepresent the Eagle Tube Company, and that our strictures on the character of their tubes are not prompted by enmity or prejudice, we hereby offer to publish free in the AMERICAN MACHINIST in full, any and all favorable testimonials, from boiler manufacturers who are using Eagle tubes, that are sent to this office. We submit to our readers whether this is not a fair proposition. It is easy to select a few good tubes either new or little used for a special test, but we very much doubt if a boiler-maker would accept the result as demonstrating the value of old redrawn tubes in comparison with new ones.

Our Industrial Exhibitions.

Industrial exhibitions are to be held this fall in New York, Boston, Baltimore, Pittsburgh, Chicago, St Louis and Cincinnati. The exhibition of the American Institute in this city will open September 11th, and continue until some time in November. Applications have been received sufficient to insure a full and creditable display of machinery, engines, boilers and pumps. We are informed that many new things are to be shown in the machinery department. The Massachusetts Charitable Mechanic Association has built a large and tasteful building for their exhibitions in Boston, adjoining the Providence depôt. An extensive display of improved machinery is promised, and the exhibition, judging from the interest awakened throughout New England, is likely to prove unusually attractive.

The Maryland Institute Exhibition will open at Baltimore, Oct. 2nd, and close Nov. 6th. Goods will be received from the 23rd, to the 28th of September. The department of engines and machinery is divided into seven groups. It is proposed by the mayor and city council of Baltimore to appropriate $100 for the purpose of providing a gold medal to be awarded, on behalf of the city, for the best display of useful machinery on exhibition, the award to be made by three citizens to be appointed by the Mayor. The Pittsburgh exposition will open Sept. 3rd, and close Oct. 5th. The Inter-State industrial exhibition opens at Chicago Sept. 4th, and closes Oct. 19th. The St. Louis exposition opens Sept. 9th. We learn from the *St. Louis Review* (which publishes complete information), that machinery hall is 248 feet long and 58 feet wide, with an annex 95x50 feet. The machinery will be divided into 6 classes, and to the best display in each class, a gold medal and a diploma will be awarded.

The Cream City Iron Works Company, Milwaukee, have just shipped four cockle-separating machines of their manufacture to Liverpool, England.

Test of a Locomotive.

On Sunday, July 28th, a locomotive of the C. H. & D. R. R. was tested for engine and boiler performance, by the well known expert John W. Hill, M. E. and a corps of skilled assistants.

The engine was a "Baldwin," four drivers and four wheeled forward truck. cylinders "16 x 24," drivers "61" and weight of engine 36 tons. The run was made from Cincinnati to Dayton, a distance of 60 miles, with a train weighing nearly 728 tons exclusive of engine and tender. The running time was 2 hours and 54 minutes, (with two stops for water,) during which time *one hundred and sixty two* diagrams were taken from each engine; and all observations of water entrained with the steam, coal consumption, water delivery, pressures, speed, blast of chimney, temperature and time, were made regularly every *two minutes*. The signals were given on the whistle, and the time noted to seconds of passing from one portion of the track to another. As this is the first complete running test of a locomotive involving the performance of engines and boiler, the report, which will be finished within four or five weeks, will no doubt be decidedly interesting to railroad men and steam engineers.

MANUFACTURES.

NEW YORK.

The Holyoke Machine Co., Manufacturers of the Deane Steam Pumps, have established a selling headquarters at 87 Liberty Street, New York City, with John H. Harris as manager.

Amor and Bowler have just fitted up a new machine shop at 170 Centre street, N. Y., for the manufacture of die work, tools, press-work, &c. They have entire new machines, and both members of the firm are experienced practical machinists.

The Buckeye Engine Co., 87 Liberty street, N. Y., have the contract for a pair of 14"x28" automatic cut off condensing engines for the new state capitol at Albany. They have just shipped a 100 h. p. engine to Gardner, Me., and have closed an order for an 150 h. p. engine for J. Monroe Taylor's Chemical Works, Brooklyn, also for one to furnish motive power for American Institute Fair.

John Robertson & Co., Brooklyn have just shipped a hydraulic press for making lead pipe to the city of Mexico; also one to Winsted, Conn., for making coffin trimmings. We noticed in their office some very fine specimens of silver plated ware, figured, equal if not superior to hand engraving, upon one of their hydraulic presses. The most beautiful designs can, in this way, be produced cheaply and rapidly. The enormous and steady pressure brings out sharply the most delicate lines.

Shop rights to use the spiral punch have been sold to a great many boiler-makers, bridge-builders, steel rail makers, &c., among which are the following: C. H. Delamater & Co., N. Y.; Fletcher, Harrison & Co., N. Y.; West Point Iron Works, Cold Spring, N. Y.; Keystone Bridge Co, Pitsburgh; Robert Munroe, Pittsburgh; Edge Moor Iron Works, Edge Moor, Delaware; Clark, Reeves & Co., Phoenixville, Pa.; Cambria Iron Works, Johnstown, Pa.; Harrisburg Car Company and Robert Tippett, Harrisburgh, Pa.; Atlas Iron Works Co.; Haugh & Co, and Skinner, Davis & Co., Indianapolis; Bartlett, Robbins & Co., Baltimore; Swift's Iron and Steel Works, Cincinnati; Standard Oil Co., Cleveland; William B. Scaife & Sons, Pittsburgh; Taylor Iron Works Co., Charleston, S. C. The inventor has taken a very sensible course in selling shop rights at a low figure, so as to leave no inducement to infringers. The use of the spiral punch effects a great saving in power and saving in strength of the metal punch.

MASSACHUSETTS.

The Worcester Wire Co., are enlarging their works to keep up to the demand for wire.

The National Manufacturing Co., Worcester, are running their shop night and day to fill orders for specialties in wire goods.

Gardner Chilson & Co.'s iron foundry at Mansfield, has started up, giving employment to some sixty men.

The Worcester Machine Screw Co. have issued a new illustrated catalogue. They find an increasing demand for screws, and their works are driven to the fullest capacity.

Lyman Wheeler, Westfield, recently sold one of his engines to the Organ manufactory at Westfield.

Witherly, Rugg & Richardson, Worcester, have issued a large illustrated catalogue and price list of wood working machinery of their manufacture. They make a very extensive variety of wood-working machines.

The Lowell Machine Shops are having large orders for Southern Work, and are employing about six hundred and twenty-five hands, with prospects very favorable for a good fall business.

The Laflin Manufacturing Co., Westfield, Mass., are now manufacturing the Rogers Patent Common Sense and Dumping Grate Bar, which is in use by a large number of the leading manufacturers throughout the country with "grate" success.

The machine shop of the Worcester Free Institute of Industrial Science is kept profitably employed in making hydraulic elevators. They are placing them in many of the principal hotels and manufactories throughout the country. The fall session of the Institute opens in the earlier part of September.

William Allen & Sons, Worcester, are making a Victor Feed Water Heater for the Crompton Loom Works, to take water from a well and purify it from lime and iron; also one for Johnson, Bye & Co., pistol manufacturers of that city. They heat the water to about 210° Some are in use that completely purify a feed of very muddy water before it enters the boiler. The mud and sediment are deposited and easily taken out.

The Worcester Boiler Works are building an 80 h. p. steel boiler for the Millers Falls Co, a 60 h. p. steel boiler for Jewett City, Conn. and a 90 h. p. steel boiler for Worcester. They are also building a 70 h. p. iron boiler for Nashua, N. H. and another of 80 h. p. for Nelson Mills, Winchendon. Among the other work in progresss is a Cottage Steam Box for a bleachery at Norwich, Conn., a bleaching kier and tank for Three Rivers Mills, besides heaters and small boilers.

Aurin Wood, Worcester, has just brought out an Improved Iron Planer, with quick return table. It is a simple device, durable, and equally well adapted to old planers as to new ones. There are two sets of pulleys on counter shafts; the difference in diamater determines the speed given the table in its return, which is very rapid. The momentum of table in its rapid return, slowed down before the change, gathers up all the back lash in gears, and entirely avoids the shock objectionable in other planers.

CONNECTICUT.

Hartford Machine Screw Co., Hartford, are running full time as usual, and doing a good business.

The New England Pin Company, of Winsted, has broken ground for a new building immediately south of its main factory, to be eighty feet long by thirty or forty feet wide.

Sawtelle & Judd, Hartford, Manufacturers of the Independent Air Pump and Condensers are getting inquiries for them from all parts of the country, and its merits are fast becoming known and appreciated.

The Pratt & Whitney Co., Hartford, shipped in July to Winchester Repeating Arms Co., a drop hammer with a 1,200 lb. hammer, the total weight of the machine being 22,000 lbs. They also shipped machinery in July, to the Davis Sewing Machine Co., Watertown, N. Y. White Sewing Machine Co., Cleveland, Ohio, American B. H. O. & Sewing Machine Co., Orange, Mass. Wheeler & Wilson M'f'g Co., Bridgeport, Conn. Victor Sewing Machine Co., Middletown, Conn. American Watch Tool Co., Waltham, Mass. Norwich Pistol Co., Norwich, Conn. Sharpe's Rifle Co., Bridgeport, Conn. Smith & Wesson, Springfield, Mass. F. W. Hood, Pistol Manfr. Norwich, Conn. Western Lock Co. Geneva, O. Meriden Silver Plate Co., West Meriden, Conn. J. Rotherham & Sons, Watch Manfrs. Coventry, England, a party in Mexico and many others.

NEW JERSEY.

Heller & Bros., Newark, have built a 125 feet addition to their File Factory, and are about to put in a 75 h. p. Corliss engine. They employ 90 hands.

OHIO.

The second steam hammer made by the Cuyahoga Works for the Otis Iron and Steel Company, Cleveland, has been set up at their works, corner of Lake and Lawrence streets, and in operation for four weeks past.

The firm of Duvall & Co., Zanesville, have taken cash orders for machinery within the last eleven days, amounting to $20,055.00. They have consequently been increasing their force of hands. The Superintendent, Mr. Korte, thinks that the work at their shops will keep up right along. They made out one shipment on Monday and will make another tomorrow. It is the excellency of their work and the promptness with which they fill orders that make this firm so successful.—*Daily Morning Times, Aug.* 8.

NEW HAMPSHIRE.

Critchley & Whalley, of Portsmouth, manufacturing machinists, make a specialty of Critchley's Patent Expanding Reamer, and have been very busy for the past year. Their exports of this tool have been large, and are increasing.

Business Specials.

Thirty cents a line for each insertion under this head.

For Drop-Forging, Packer Ratchet Drills, Lathe Dogs, Screw Plates and Dies Address, The Billings & Spencer Co., Hartford, Conn.

Frasse & Co., 62 Chatham Street, N. Y. have the most complete assortment of Machine Screw Taps for Machinists, Gunsmiths, Sewing Machine Manufacturers and others, of any house in this country. Also a full line of Chucks, Twist Drills and Fine Tools of every description.

Patent of Sectional Boiler for sale, or manufacture on royalty; cheap to construct, positive circulation. Scale or mud cannot deposit on heating surface, safe, strong and entirely practical. Address, Geo. A. Barnard, 87 Liberty Street, New York.

Jackson & Tyler, Baltimore, Md., have published a complete catalogue on Lathes, Saws, new tools for Machinists and others, Small Engines, &c.; 140 pages. Sent on receipt of 3 cents stamp.

The Pratt & Whitney Co., of Hartford, Conn., make a specialty of Cutters for the teeth of gear wheels, that are shaped entirely by machinery and will make interchangeable all gears that are cut with cutters of the same pitch.

National Steam Pump, simple, reliable and durable. Send for illustrated catalogue with reduced price list. W. E. Kelly & Brother, 46 Cortland St. New York.

Machinery Depot—New, and second hand Iron, and Wood working Machinery and Steam Engines,—E. P. Bullard, 14 Dey St., New York.

The George Place Machinery Agency, 121 Chambers and 103 Reade Sts., New York. Iron Machinery of every description. Patent Cold Rolled Shafting, Pulleys, &c.

The Norcross Steam Damper Regulator, the only reliable pressure Governor in the world, manufactured by The Laflin manufacturing Co., Westfield, Mass.

Questions and Answers,

Under this head we propose to answer questions sent us, pertaining to our specialty, correctly and according to common sense methods.

(1) F. G. Fitchburg, Mass. writes: In answer to J. J. G's question in June issue in regard to laying out the finger board of a guitar, or banjo, I would say that there is a way to get it mechanically as well as musically correct. The way to do it is this. Take the distance between the bridge and nut, divide this into 18 parts, place a fret on the one-18th part and divide the remainder into 18 again, and so on until the whole length of the neck is fretted, or as much as is wanted. Whether this is the rule used by the professional makers I can not say, but he will find it to be perfect.

(2) V. E., Peekskill, N. Y. asks if there is any way to solder gray cast iron. A. Use a solder composed of two parts of tin and one part of lead. The iron can be heated in an open fire. Use a flux of sal ammoniac with common resin.

(3) W. A., Newark, N. J. wants a solution to take sand off castings. A. Sulphuric acid and water will do it.

(4) R. N. L, Winchendon, Mass. asks for a remedy to prevent screws from working out. A. Cut a series of notches across the thread around the screw so that the thread will be formed into a series of teeth similar to those of a ratchet wheel. The teeth will not retard the screw in entering, but on turning it the opposite way will catch in the wood and prevent working out.

(5) H. F., Middletown, N. Y. asks how to restore old files to usefulness. A. Remove all oil and grease by boiling for half an hour in a strong solution of rain water and saleratus, after which wash and dry well. Next take water, ½ gallon, sulphuric acid, 8 ounces: mix in an earthen or glass jar. For coarse files 10 to 12 hours time is required to recut, while for fine ones only five or six hours are necessary. Put in the coarse files first and the fine ones a few hours afterward, so all may be taken out at once: Sponge them off in boiling water that they may dry quickly, and apply sweet oil to prevent rust. If a file has been used in soft metal, 3 or 4 hours is long enough to keep it in the solution.

(6) J. C. G., Marlboro, Mass., writes: Please tell me the most economical speed an engine should be run, and how much larger should it be for the amount of work it has to do. I have noticed small engines that were doing a full amount of work use a large amount of steam? A. The most economical speed for an engine properly loaded is the highest piston speed possible, consistent with its design and proportions. This subject is not fully understood or appreciated, and we propose to write it up in a comprehensive manner for our next issue.

Improvements in the Steam-Engine Indicator.

BY STEPHEN ROPER, ENGINEER.

Perhaps no other device in the entire range of mechanical inventions has aided so much in developing and perfecting the steam engine as the Indicator. This arises from the fact that no other invention yet brought forward, pertaining to the science of steam engineering, can read the inner workings of a steam engine, point them out with unerring accuracy, and discover the sources of waste in it; consequently, its importance can not be too highly estimated, and its use too much encouraged and extended in all classes of steam engines.

The steam engine indicator was invented by James Watt in 1790; he kept its construction, and even its existence, a secret for several years. A great deal of curiosity was manifested by engineers and steam users as to why he should drill holes in the cylinder heads of his engines, and stop them up again. Watt's indicator, though very imperfect, answered for engines traveling at a piston speed of about 150 feet per minute, and for pressures averaging 7 pounds above atmosphere; which he thought was the fastest speed and the highest pressure that would ever be needed. But experience soon demonstrated that the highest economy was attained with high piston speeds and correspondingly high pressures, and as a result Watt's indicator proved to be unsuitable for these conditions. The requirements of such an instrument were more fully appreciated by McNaught of Glasgow. The world is more indebted to him for improvements in the steam engine indicator than to any one previous to his time.

The indicator was further improved by Hopkinson, Stillman and others; but these improvements were not in the mechanical design, or arrangements of its working parts, but rather in the accuracy and refinement of the workmanship employed in its construction, as the mechanical principles embodied in the Watt Indicator were continued in them all. They consisted of an upright cylinder into which a piston was accurately fitted. To the piston-rod a spiral spring was attached to resist the vacuum and steam pressure when acting against it. The pencil was also attached to the piston-rod, the result of which was that the piston, piston-rod and spring had the same movement as the pencil. With such instruments the vibration of the piston was so great as to render them totally unreliable with fast running engines, or when steam was worked expansively. Fig. 2 was taken by one of these primitive instruments.

Gooch was the inventor that gave the pencil a greater range of movement than the piston. In his instrument the cylinder was placed horizontally, and when its piston was subjected to pressure it compressed two elliptic springs. The top of his piston-rod was connected to the short arm of a lever, to the long arm of which the pencil was attached—thus giving considerably more motion than could be obtained by any former instrument. The pencil moved in the arc of a circle instead of in a straight line. The diagram was traced on a web of paper, while it was unwound from one drum and wound upon another. This arrangement admitted of a succession of diagrams being taken without any intermediate manipulation of the instrument. The communication between the indicator and the cylinder was closed by a slide-valve instead of a cock. But as the principle of working steam expansively became almost universal, an instrument more reliable than any previously mentioned, became a necessity of the times, and such was found in the Richards Indicator.

In this instrument the following proportions and construction have been adopted and adhered to from the first. The area of the piston is one-half a square inch. The length of the long arm of the lever to which the rod of the piston is attached is 3 inches, and the distance from the pivot of the lever to the point of attachment of the piston is ¼ of an inch, thus giving the free end of the lever

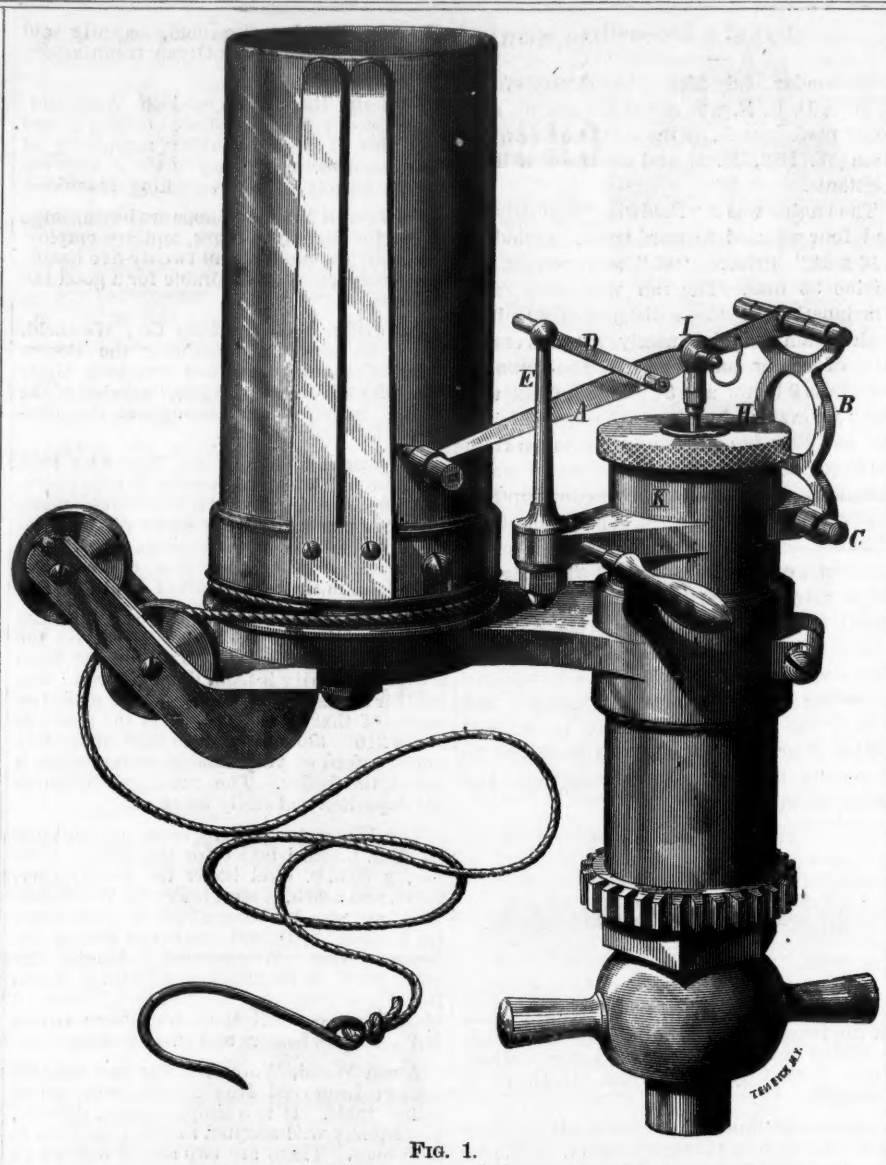

FIG. 1.

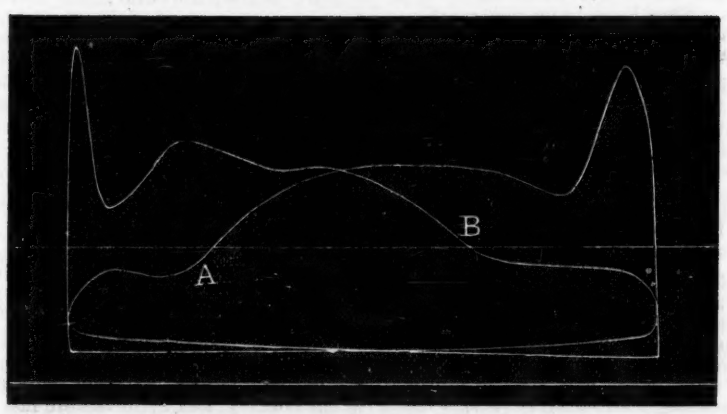

FIG. 2.

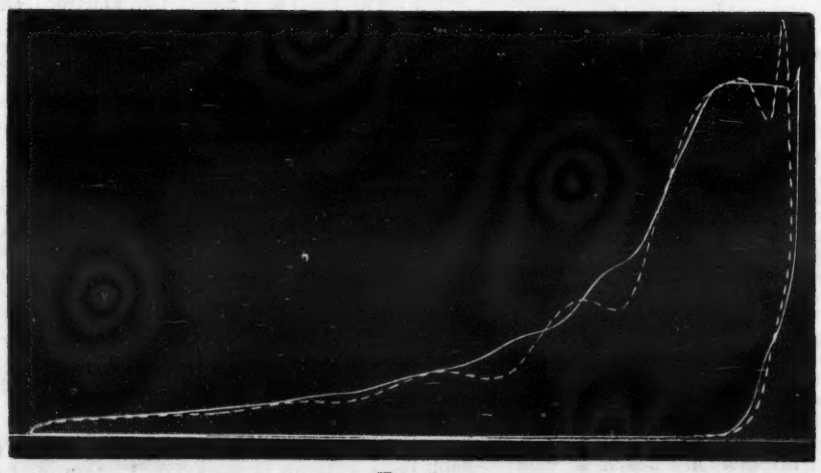

FIG. 3.

and with it the pencil four times the movement of the piston. The secondary lever is equal in length to the first, and the link which connects the two, and which carries the pencil at its centre is 1⅞ inches long. These proportions give a practically straight pencil movement for a distance of 2½ inches.

As the tendency of the times for the past 15 years has been to regulate the flow of steam from the boiler to the cylinder automatically instead of by throttling, it became manifest to engineers that an instrument that would take faithful diagrams from fast running engines, particularly those in which the change of pressure and work are necessarily great, was one of the necessities of the age. Such a want has been successfully supplied by J. W. Thompson, a distinguished mechanical engineer and inventor of Salem, Ohio.

In Thompson's Indicator, as shown in Fig. 1, the pencil is inserted in the end of the lever A, which end is constrained to move in a straight line by the light radius bar D, which is pivoted at one end to the fixed standard E, and at the other to the lever. The lever is pivoted to the bracket B, which in turn is pivoted at C, with the freedom of movement necessary to allow the radius bar D to determine the path of the pencil. In order that equal movements of the piston of the instrument may be represented by equal movements of the pencil lever through its entire range of movement, the connecting-rod between them, which is attached to the lever A at J, is made as much longer than the bracket B, as its lateral vibration is greater. This brings its lower end down nearer the piston, to which it is connected by a universal compensating joint, which allows both the lateral vibration required by the parallel movement, and the partial rotation of the head K required to bring the pencil to and from the paper. Above this joint the stem is continued in the form of a hollow trunk.

Fig. 3 is an exact transfer from two diagrams taken separately from the same end of the cylinder of an automatic cut-off engine, 10x18 inches, speed 170 revolutions per minute, scale of indicator 40 pounds per inch. The dotted lines represent the card made by the Richards, while the plain lines show that made by the Thompson, indicator. A comparison reveals the fact that the correct average pressure cannot be ascertained from a diagram which is distorted by vibration, and also that its indications are deceptive, as to admission, cut off and compression, all these events appearing more tardy, for the obvious reason that the heavier parts do not respond so promptly to changes of pressure as the lighter.

The most recent improvement in the indicator has been effected by John W. Sweet, Director of Machinery, of Cornell University, by which it is claimed that diagrams may be taken from engines running at a very high speed; but it is doubtful if his improvement will admit of much lighter parts than "Thompson's." Prof. Sweet's torsion spring is correct in principle, but introduces a very awkward shape. His arrangement to give motion is ingenious and handy, but it is doubtful if it will pay, except when taking diagrams is a permanent business.

Emerson, Smith & Co., of the Beaver Falls, Pa., saw works, are using natural gas in their tempering furnace; they say it is much superior to coal in every way, and is very much cheaper. They contemplate to use it under the boilers, and for warming the shop in the winter.

Machinists' and Engineers' Supplies.

The market is very dull, but not unusually so for this season of year. Some of our machinists' supply houses report an improved trade, and others an almost complete stagnation. It is anticipated that a fair trade will be done this fall, and that prices have reached their lowest ebb. Lathrop & Co., Newark, are introducing a new lathe dog, made from bar steel. The sizes range from ⅜" to 3", and prices from 50 cents each to $1.80. H. Prentiss & Co. have issued a new sixty-seven page illustrated catalogue of taps, dies and machinist's supplies. In the preface they state that their factory at Essex, Conn, is fully equipped with new and improved machinery and accurate gauges for the production of taps and dies of unusual excellence. "Our aim," say they, "is absolute perfection both as to quality and finish." The catalogue shows ten different styles of chucks, and a general line of supplies for the shop. The Useful Machinery Co. have adopted the following scale of prices for their tubular foot lathes.

TUBULAR FOOT LATHES,

INCLUDING TABLE TWO CENTRES AND THREE T RESTS.

No. 1, 17" long 6 inch swing	$20
" 2, 24" " 7¼ " "	25
" 3, 30" " 8½ " "	30

The Brown & Sharpe M'f'g. Co., have reduced the price of their Micrometer Caliper to $5; in Morocco case, $5.50. Their sheet metal gauge is offered at the same price. These tools are susceptible of very wide application where accuracy of machine work is sought for.

Thos. Prosser & Son have issued the following price list for their boiler tube expander:

Price list—patent Combined Expander and Cutter.

(The upper line shows diameter of tube in inches.)

1, 1¼, 1⅜, 1¾, 2, 2¼, 2½, 2¾, 3, 3¼, 3½, 4, 4½, 5, 6, 7.
$20, 20, 22, 23, 25, 27, 30, 33, 35, 38, 40, 45, 55, 70, 90, 110.

Price List Prosser Expander.

1, 1¼, 1⅜, 1¾, 2, 2¼, 2½, 2¾, 3, 3¼, 3½, 4, 4½, 5, 6, 7.
$8, 8, 9, 11, 12, 13, 15, 1-, 22, 26, 30, 33, 37, 42, 60, 75.

Mr. W. Heuermann has lately opened an office and warehouse at 40 John street, New York, as sole agent for Schaffer & Budenburg, Buckan-Madgeburg, Germany, manufacturers of steam, blast vacuum hydraulic and other gauges. Their gauges have been sold in the United States since 1860.

BOILER-MAKERS SUPPLIES.—Trade is improving, but prices are not. We quote as before: Tank Iron @ 2¾; C, No. 1, @ 3; Shell @ 3¼; Best Flange @ 4½; Soft Patch @ 6¼; Boiler Rivets @3¾; Boiler Tubes list price less 40% discount. Mill prices furnished on application.

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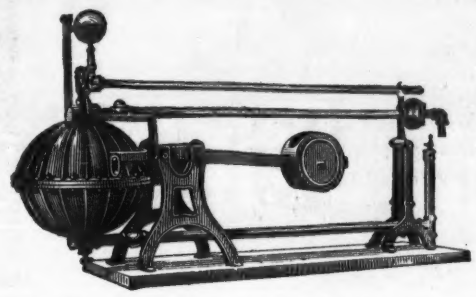

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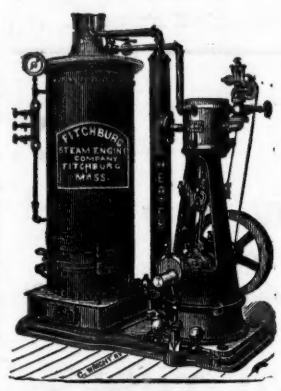

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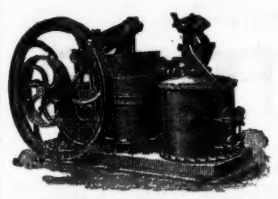

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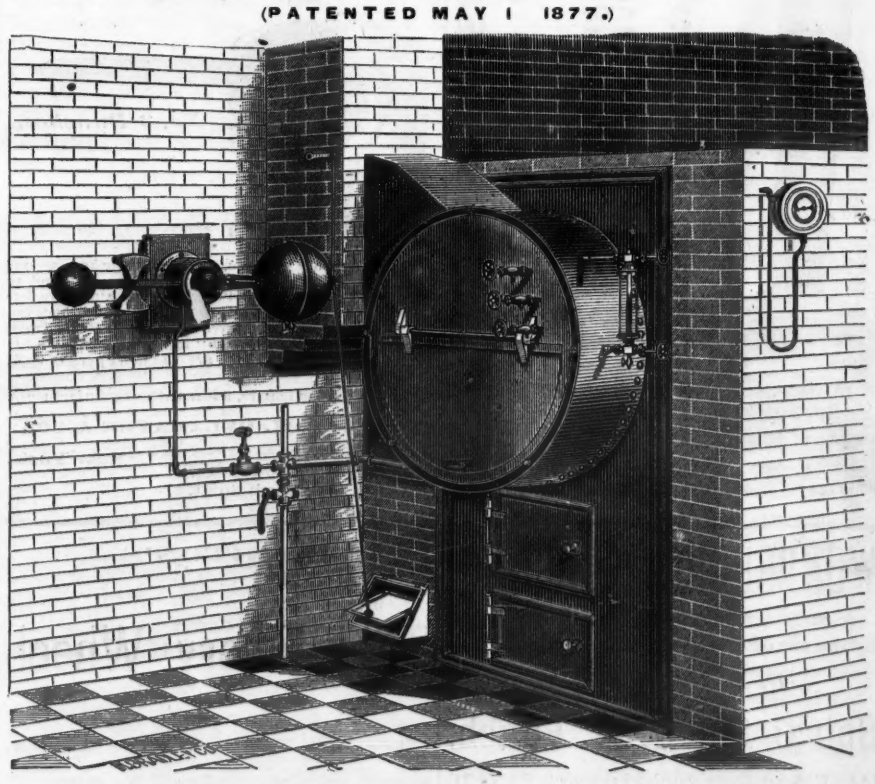

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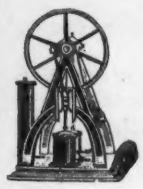

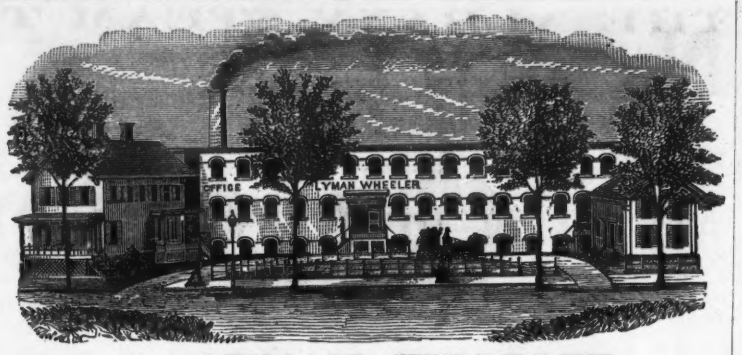

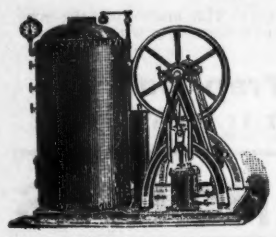

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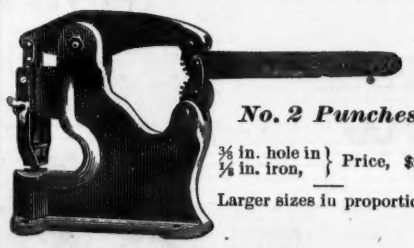

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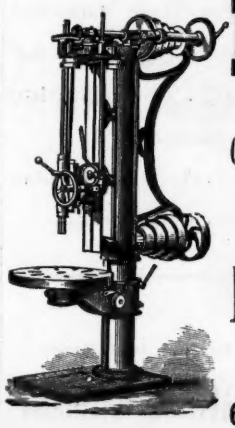

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AND OTHER

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Punches, and Roller Tube Expanders,

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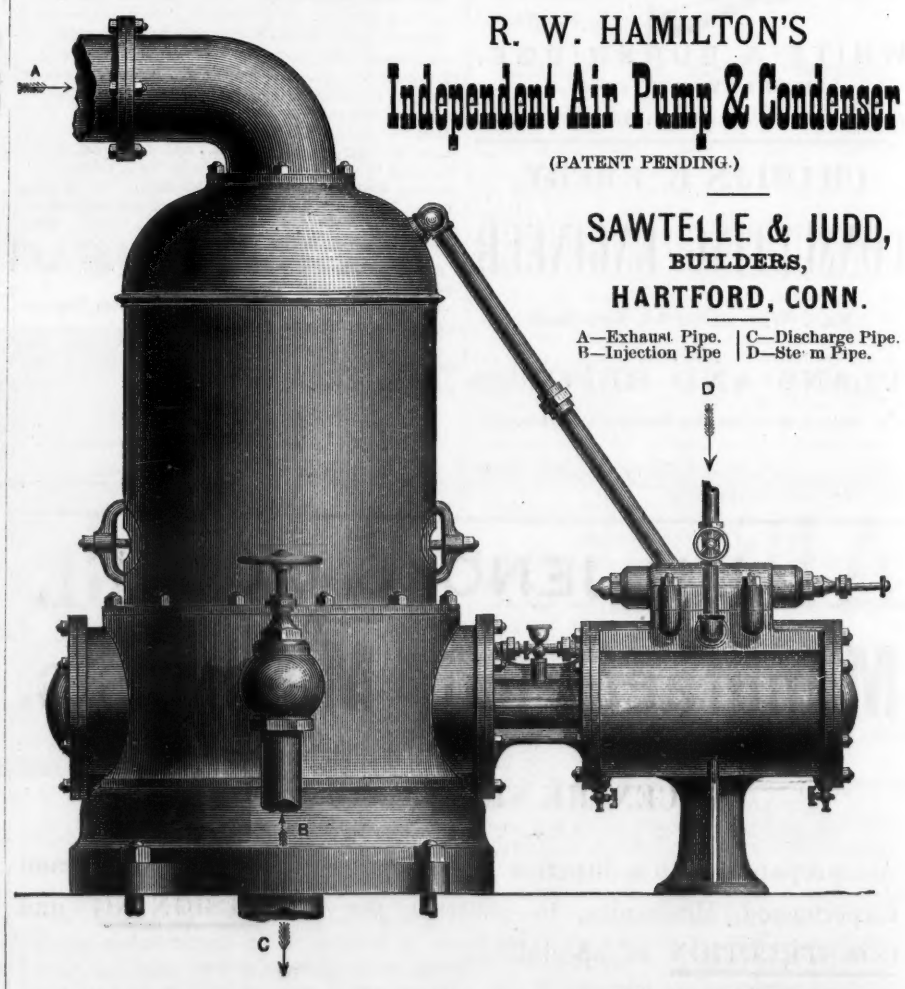
Jacks for Pressing on Car Wheels or Crank Pins made to order.

R. W. HAMILTON'S

Independent Air Pump & Condenser

(PATENT PENDING.)



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BUILDERS,

HARTFORD, CONN.

A—Exhaust Pipe. B—Injection Pipe | C—Discharge Pipe. D—Steam Pipe.

This Condenser has been designed especially to meet a want long felt for something capable of being readily applied to non-condensing engines, to economize fuel or add to the power. In applying this Condenser to engines now located, it is only necessary to choose the most convenient place for water connections and lead the exhaust to it. By its application, we guarantee an increase, in most cases, of 30 per cent. in power, or where that is not desired, 20 to 25 per cent. in fuel saved. A great reduction in boiler pressure may be obtained where increase in power is not required, and this is very desirable in some cases

For further particulars, and reference to those having this Condenser in use, apply to

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Office 24 Broadway, N. Y.

Established 1790.

IMPORTERS AND DEALERS IN IRON AND STEEL OF EVERY DESCRIPTION,

Warehouse, 24 and 26 Broadway, and 77 and 79 New Street,

New York City, August 15, 1878.

TERMS, NET CASH IN 30 DAYS. **PRICES SUBJECT TO MARKET CHANGES WITHOUT NOTICE.**

COMMON IRON.

	Price Per Lb.
1×⅜ to 6×1 Flat,	$1\frac{8}{10}$
1¼ to 6×¼ and $\frac{5}{16}$ Flat, / 1 and 1½×¼ and $\frac{5}{16}$ Flat,	2
⅜ and 2 Round and Square,	$1\frac{8}{10}$
⅝ and 1¼ " "	2
½ and $\frac{9}{16}$ " "	2

REFINED IRON.

1×⅜ to 6×1 Flat,	2
1 to 6×¼ and $\frac{5}{16}$ Flat,	$2\frac{3}{10}$
⅜ to 2 Round and Square,	2
2⅛ to 2⅞ " "	$2\frac{3}{10}$
3 to 3½ " "	$2\frac{4}{10}$
3⅝ to 4 "	$2\frac{7}{10}$
4⅛ to 4½ "	3
4⅝ to 5 "	$3\frac{3}{10}$

RODS, ROUND AND SQUARE.

$2\frac{1}{10}$	$2\frac{2}{10}$	$2\frac{6}{10}$	$2\frac{8}{10}$	3	$3\frac{1}{10}$	$4\frac{2}{10}$
⅜ & $\frac{11}{16}$	½ & $\frac{9}{16}$	$\frac{7}{16}$	⅝	$\frac{5}{16}$	¼	$\frac{3}{16}$

Ovals, Half Ovals and Half Rounds.

$2\frac{6}{10}$	$2\frac{8}{10}$	3	$3\frac{5}{10}$	$3\frac{7}{10}$
¼ to 2	⅜ & $\frac{11}{16}$	½ & $\frac{9}{16}$	$\frac{7}{16}$	⅜

BAND.

1 to 6×$\frac{3}{16}$ to No 12,	$2\frac{8}{10}$

HOOP.

$5\frac{8}{10}$	$4\frac{4}{10}$	$3\frac{6}{10}$	$3\frac{4}{10}$	$3\frac{1}{10}$	3	$2\frac{7}{10}$
½	⅜	¼	⅞	1	1⅛	1¼ & up'ds

HORSE SHOE.

¼×⅜ to 1⅛×⅝	$3\frac{3}{10}$

SCROLL.

$4\frac{8}{10}$	$4\frac{8}{10}$	4 $\frac{8}{10}$	$3\frac{8}{10}$	$3\frac{6}{10}$	$3\frac{4}{10}$
½×16	14	12	10	$\frac{3}{16}$	¼ & $\frac{5}{16}$
$4\frac{2}{10}$	$3\frac{8}{10}$	$3\frac{5}{10}$	$3\frac{3}{10}$	$3\frac{1}{10}$	3
⅝×16	14	12	10	$\frac{3}{16}$	¼ & $\frac{5}{16}$
$3\frac{4}{10}$	$3\frac{2}{10}$	3	3	$2\frac{8}{10}$	$2\frac{7}{10}$
¾×16	14	12	10	$\frac{3}{16}$	¼ & $\frac{5}{16}$
$3\frac{2}{10}$	$3\frac{1}{10}$	3	$2\frac{8}{10}$	$2\frac{7}{10}$	$2\frac{6}{10}$
⅞×16	14	12	10	$\frac{3}{16}$	¼ & $\frac{5}{16}$

	c.
Norway Bar Iron,	5
" Shapes,	6
Nail Rods, P. & Co., 6c., or U. B.	6
Angle Iron,	$2\frac{6}{10}$
Tee Iron,	3
Sheet Iron, Common,	3
Boiler Plate,	$2\frac{5}{8}$ @
Best Flange,	$4\frac{1}{2}$ @ 5

EXTRA REFINED IRON.

Equal to H. B. & S. B. B. H. BAGNALL'S or L. W.

Ordinary Sizes.

ROUND AND SQUARE, ⅜ to 2 in. / FLATS, 1×⅜ to 6×1,	Price per lb. $2\frac{3}{10}$c.

Extras same as Refined.

ULSTER BEST IRON.

PIERSON & CO. keep in stock a full assortment of this well known extra brand.

Ordinary Sizes.

	Price Per Lb.
¼ to 2 Round and Square, / 1¼×⅜ to 4½×1,	$3\frac{5}{10}$c.

Extras on Rounds and Squares.

¼	$1\frac{8}{10}$	⅝ and $\frac{11}{16}$	$\frac{9}{10}$
$\frac{5}{16}$	$1\frac{1}{10}$	2⅛ to 2⅝	$\frac{9}{10}$
⅜	$\frac{8}{10}$	2¾ to 3	$\frac{9}{10}$
$\frac{7}{16}$	$\frac{6}{10}$	3¼ to 3½	$\frac{6}{10}$
½ and $\frac{9}{16}$	$\frac{4}{10}$	3¾ to 4	$\frac{5}{10}$

Extras on Flats.

$1\frac{8}{10}$	$1\frac{1}{10}$	$\frac{8}{10}$
⅝×⅛ and $\frac{3}{16}$ $1\frac{1}{10}$	¼ and $\frac{5}{16}$ $\frac{8}{10}$	⅜ to ½ $\frac{6}{10}$
¾×⅛ and $\frac{3}{16}$ $\frac{8}{10}$	¼ and $\frac{5}{16}$ $\frac{6}{10}$	⅜ to ⅝ $\frac{4}{10}$
⅞×⅛ and $\frac{3}{16}$ $\frac{4}{10}$	¼ and $\frac{5}{16}$ $\frac{3}{10}$	⅜ to ¾ $\frac{2}{10}$
1×⅛ and $\frac{3}{16}$	¼ and $\frac{5}{16}$	⅜ to ⅞

$\frac{4}{10}$	$\frac{3}{10}$	$\frac{3}{10}$
1⅛×⅛ and $\frac{5}{16}$	¼ and $\frac{5}{16}$	⅜ to 1
1¼ to 4½×¼ and $\frac{5}{16}$, " ×1⅛ to 2		$\frac{2}{10}$
4¾ to 6×⅜ to 1		
4¾ to 6×¼ and $\frac{5}{16}$ " ×1⅛ to 2		$\frac{4}{10}$
6½ to 7×⅜ to 1		
2¼ to 3×2⅛ to 2¾		
6¼ to 7× ¼ and $\frac{5}{16}$ " ×1⅛ to 2		$\frac{6}{10}$
3¼ to 4×2⅛ to 3		

Ovals.

$\frac{8}{10}$	$\frac{6}{10}$	$\frac{4}{10}$	$\frac{3}{10}$
½ and $\frac{9}{16}$	⅝ and $\frac{11}{16}$	¾	⅞ & up.

Half Ovals and Half Rounds.

$1\frac{3}{10}$	$1\frac{1}{10}$	$\frac{8}{10}$	$\frac{4}{10}$
½ and $\frac{9}{16}$	⅝ and $\frac{11}{16}$	¾	⅞ & up.

Ulster Horse Shoe,	$3\frac{5}{10}$
Esopus " "	$3\frac{4}{10}$

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Special Rates Given on Application.

Iron and Steel Rails; Railroad Chairs and Spikes; Railroad Fish Plates; Bolts, &c.; Railroad Axles and Wheels; Wire Rods; Screw Rods; Gas and Steam Tubes; Nails; Rivets; Tank Iron. Wrought Iron Beams, Deck Beams, Channel Bars, Star Iron, Octagonal Post Iron, "Upset" Chord Bars, Angle and Tee Iron.

"Universal Mill" Plates.

Plates not over 24 in. wide, ×3-8 to 7-16.
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All plates over **30** feet long, weighing **1000** lbs. or over, subject to **special agreement only.**

These Plates are not Sheared.

Edges guaranteed perfectly solid, straight and of uniform width, rendering reshearing unnecessary when exactness is required.

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All Steel, 6½ c.

STEEL,

Foreign & Domestic

English Cast Steel,	16
" Spring Steel,	6
" Tire Steel,	6
" Toe Calk Steel,	6
" Machinery Steel,	9
Bessemer Wire Rods,	3½
American Bessemer Tire Steel,	
" 3-16 up,	5c
" " " " 5-32 up,	5¼
" " " " 1-8 "	5½
" " " " 3-32 "	5¾
" Spring Steel,	5
" Tool Steel,	13
" Machinery Steel,	7
" Toe Calk Steel,	5
" Plow Steel,	6
" Sleigh Shoe Steel,	4
" Bessemer Steel,	7
" Steel Crowbars,	6½

STEEL FORGINGS TO ORDER.

A discount of one tenth from above list on Refined Iron is given to dealers.

REVIEW.

Prices are without change since our last issue, but the competition for orders is somewhat less keen than it was, and there is not the disposition on the part of the manufacturers to make concessions that characterized negotiations a month or so back and which so disorganized the market. The point at which production becomes un-remunerative has been reached, and rather than incur increased losses by still further reducing prices, makers prefer not to sell at all, nor do they show any increased willingness to look ahead at existing rates, as the hope still appears to prevail that a rally from the present depressed and unsatisfactory state of things will take place at no distant date.

PIERSON & CO., 24 Broadway.

Alligator Wrench.

Simple, Effective, Light and Portable.

A set being only a *sixth of the weight* of a set of gas-tongs of equal calibre.

There are five sizes. The length of No. 1, 5¾ inches; No. 2, 10 inches; No. 3, 16 inches; No. 4, 22 inches; No. 5, 27 inches.

	No. 1.	No. 2.	No. 3.	No. 4.	No. 5.
Holds pipe	⅛ to ⅜	⅛ to ¾	⅛ to 1¼	1¼ to 2	2 to 3
" Round Iron	¾ to ¾	½ to 1	¾ to 1⅜	1⅜ to 2⅝	2¼ to 3½

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SOLE GENERAL AGENTS,

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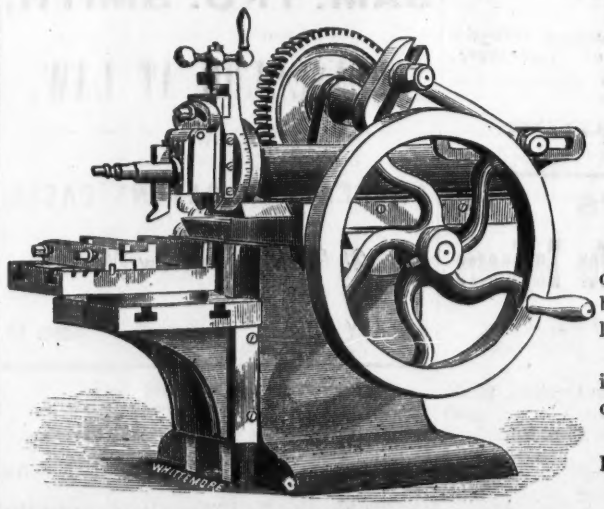

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Manufactured by

E. N. BOYNTON,

WORCESTER, MASS.

This machine has a stroke of six inches, and may readily be adjusted to work of any less distance.

Length of Traverse, eight inches. Vertical adjustment of table, three inches.

Can be run by hand or power.

Weight, 225 lbs.

Screws made to Order

Every variety of Gun, Sewing Machine, and small Machine Screws, Collars, Caps, Studs, &c., &c. Also, Light Hardware, and Specialties in Metal, Sheet Brass Work, Trimmings, Sewing Machine Attachments, Punches, Dies, Stamps and Special Tools.

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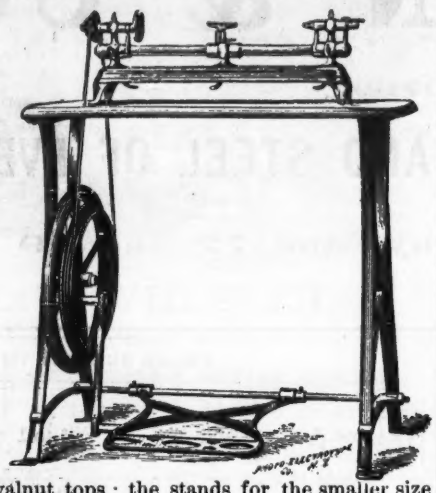
New Tubular Foot Lathes.



We offer a Foot Lathe made on a new principle, with many advantages over the ordinary Lathe, and having various attachments which give it a wider range of usefulness, and adapt it to the needs of all classes.

For the Inventor it will save time and money, as it will enable him to make his own models.

For the Jeweler it will prove a cheap and effective instrument.

The Dentist will find that it supplies a need long felt in his business,

For Gentlemen of leisure, Clerks, Students, etc., it will prove an agreeable pastime.

For the Jobbing Workman it is of incalculable value on account of the infinite variety of work which can be done upon it, and for one out of business, it affords a ready means of earning a livelihood.

They are made of the best materials, the spindles, centers, and all working parts of steel; the bright parts nickel plated, the other parts japanned, and are mounted upon strong and handsome stands, with black walnut tops; the stands for the smaller size being low, so that the operator can use them while seated.

The Head Stock, Tail Stock and Rest

slide upon a central guide bar, by which they are kept at all times in line, and, by a neat device, are securely clamped to the bed when in use. The Spindles are both hollow, enabling the operator to turn rods of indefinite length by the use of a small attachment which we make.

All Parts are Interchangeable,

so that should any part be broken a new one which will fit, can be obtained by sending the number of the lathe to us.

We are getting up various attachments, such as Jig Saw, Circular Saw, Gear Cutter, and others, which, as they will fit any of our Lathes, can be ordered as needed.

They are Artistic in Design,

and will be an ornament to a sitting room, while they are sold at as low prices as the poor articles usually found upon the market.

An examination will show the infinite variety of work to which they are adapted.

Each Lathe is furnished with a stand, one face plate, two centers and three T rests.

No. 1 is 17 inches long, swings 6 inches, price $20.
No. 2 is 24 inches long, swings 7¾ inches, price 25.
No. 3 is 30 inches long, swings 8½ inches, price 30.
Lathes all Nickel Plated $5 Extra.

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COMBINATION TURNING AND SCREW TOOL.

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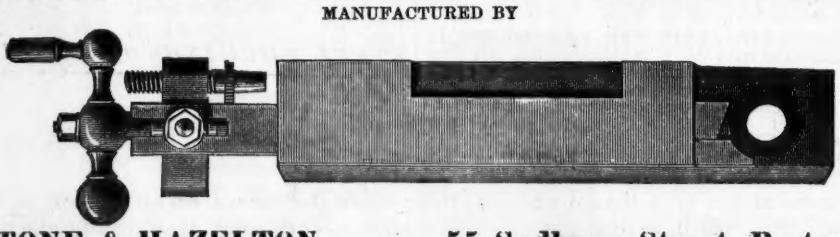

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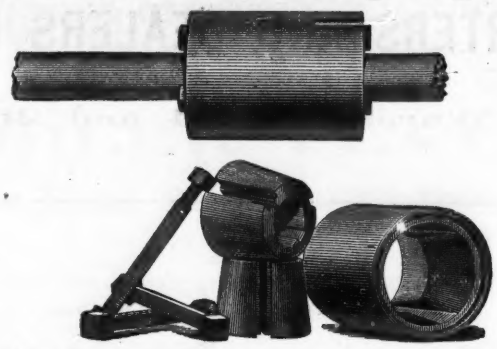

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Special Locomotive Tube,

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Made of Boiler Tubes and Steel Rods, giving a GREAT SAVING of

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From ⅛th to 14 inches Diameter.

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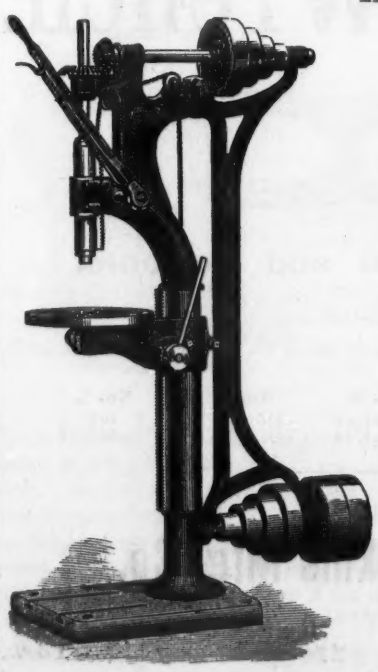

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A SPECIALTY.

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The Victor Patent Adjustable Pipe Wrench,

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Are STRONGER, work EASIER, hold FIRMER, are LIGHTER, more DURABLE and CHEAPER than any other Pipe Wrench made.

No. 1 Wrench, weighing 6 lbs., takes Pipe from 1-8 to 1 1-4 inch.
No. 2 " " 15 " " " " 1 inch to 4 inches.

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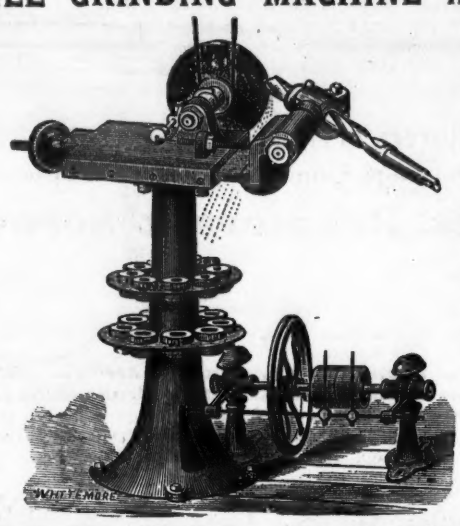
☞ Requires no skilled workman to run this machine. Either Crooked or straight drills ground quickly and accurately.



This Machine grinds drills to the same shape as the best machinists do by hand. It enables the operator to make the cutting edge or lip of the drill thick and strong so it will not crumble away in drilling, also to make the lip true with the twist or outside surface

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Feed-Water-Heater and Purifier,

FOR

HEATING AND PURIFYING WATER

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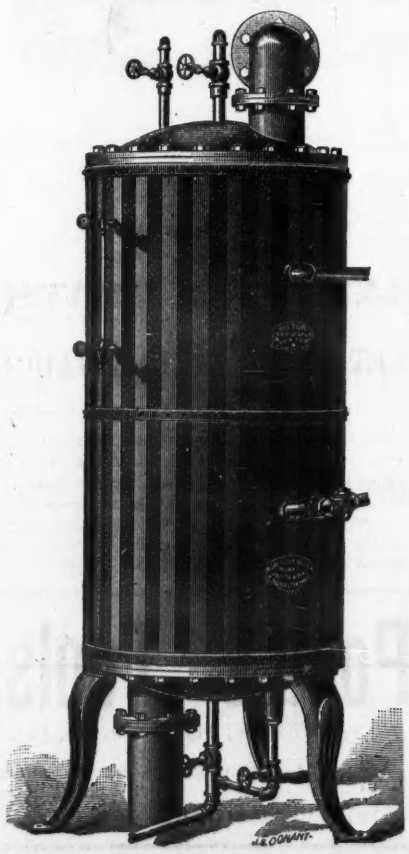

(Jones' Patent, Nov. 6, 1877.)

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One "Pond" Index Milling Machine.
Three Chase Patent Pipe Cutting Machines.
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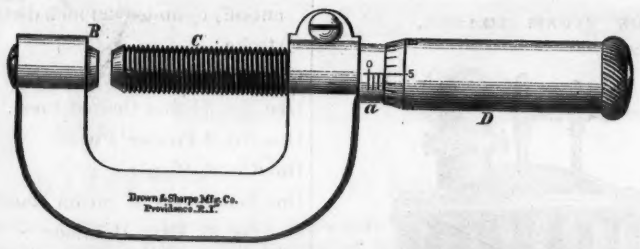

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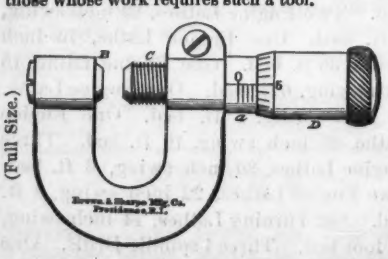

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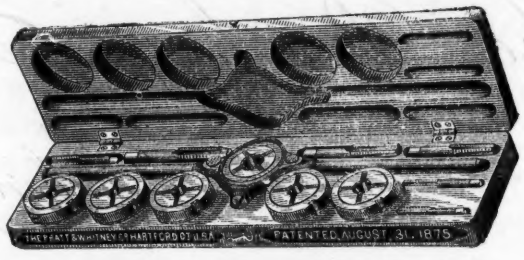

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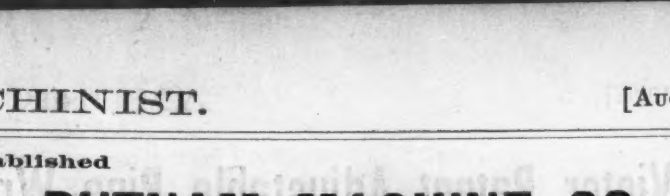
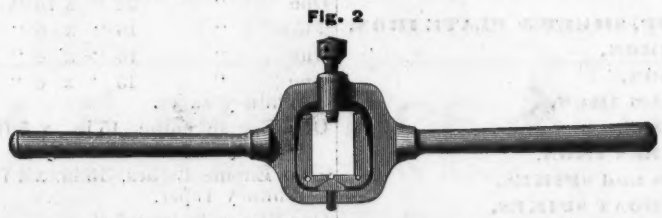
Fig. 3 Fig. 1 Fig. 4



This Screw Plate is drop-forged from the best bar iron and steel for the purpose. The arrangement for holding in the Dies is novel and new. Two feathers hold the Dies in position, as shown in cut Fig. 2, swing in and out. By turning the screw from the top Die, and press on the pin at lower edge of the plate, leave the Dies free to drop out. Fig. 3 represents a pair of Dies for holding Taps used in the plate in place of Thread Dies, making a very convenient Tap Wrench, saving the necessity of an extra wrench as it combines the two.

Fig. 2



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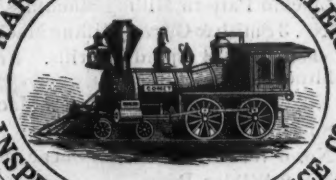

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